Railway Engineering and Maintenance

AUGUST, 1938

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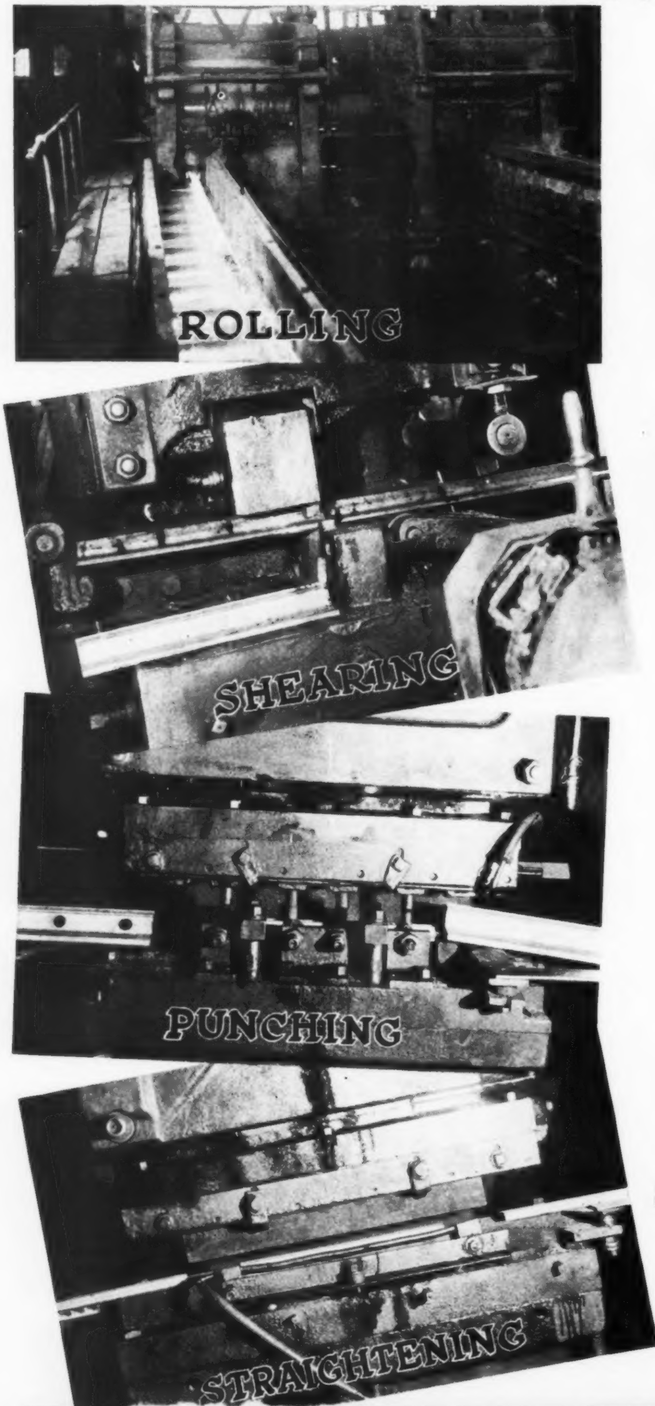
Behind the Scenes



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(Right) Clean ditches aid drainage and decrease fire hazards. Here a Model WM tractor and Hough loader clean a ditch along an Illinois right-of-way and build up the roadbed by casting the excavated material on the shouiders.

(Below) Model WM, with Hough bulldozer blade replacing bucket, backfilling over a pipeline.

(Bottom) Loading packed snow out of a yard in zero weather. This outfit can be equipped with either angular or V-type blade for pushing snow.

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"I appreciate that fact, Bill."

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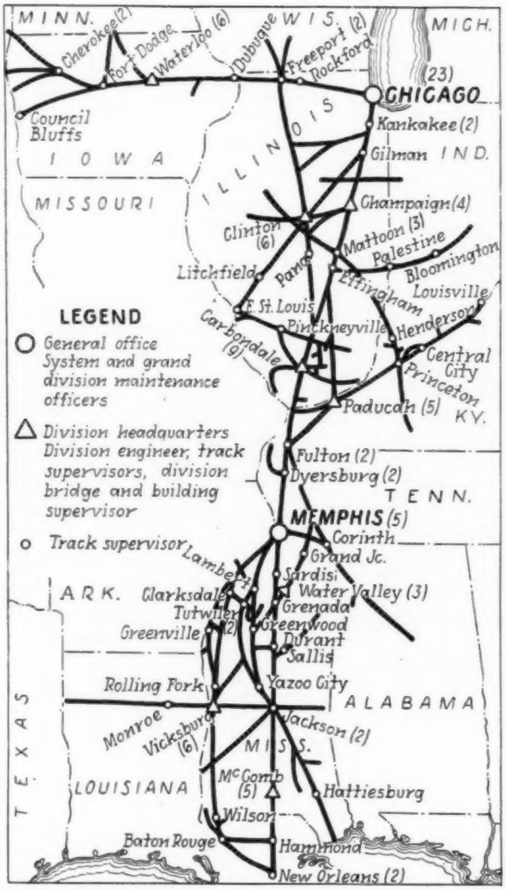

Railway Engineering and Maintenance Goes Every Month to 124 Supervisory Maintenance Officers on the Illinois Central at 2 General Offices, 10 District and Division Headquarters and 41 Other Roadmasters Headquarters Scattered All the Way from Cherokee, Iowa, to New Orleans, La. This Magazine Also Goes to 217 Other Subordinate Supervisory Officers Who Are in Training for Promotion to Supervisory Positions.

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"By gad, Boss, that's a swell idea."

RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

No. 116 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Whose Job Is It?

August 1, 1938

Dear Reader:

"It is a pity that the public at large does not read your magazine more widely, for it would give the people a different picture of the progress that the railways are making than many of them now have. I never pick up an issue of Railway Engineering and Maintenance that I do not find a veritable panorama of new ideas, new methods and new materials that you have gathered from widely scattered areas and brought to my desk within the covers of your magazine. No one could read this paper month after month without realizing that the railway industry, with all of its difficulties, is still a virile industry and that it is forging ahead more rapidly than many other industries that are today regarded as more progressive by the public."

This statement was made to me a few days ago by the general manager of one of our large railways. You and I know that it is an accurate statement of the progress that the railways, and especially the maintenance of way departments, are making. You and I know also that there has never been a time when the railways were more alert to new ideas than today or were giving as good service.

But does the public appreciate these facts? I am sure that you find that in general it is friendly to the railways. However, do you find that it appreciates the great strides that the railways have been making in service of late? If it does not, whose fault is it? Are we not largely responsible if our neighbors are unfamiliar with the accomplishments of our industry? Are we doing all that we should in disseminating facts that will reflect credit on the industry from which we derive our livelihood? Are we overlooking an opportunity to improve the standing of one of America's greatest industries and at the same time promote our own interests?

Yours sincerely,

Elmer T. Howson

Editor

ETH:EW

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Railway Engineering and Maintenance

Waterways

Who Is Paying the Bill?

IN THE annual report of the operations of the Inland Waterways Corporation for 1937, that was recently made public, the net income from operations for the year is reported as $253,935. In submitting this report, General Ashburn stated that the operation of this federal barge line saved shippers $2,215,000 last year. These statements again bring to the fore the question of the economy of waterway transportation on the interior rivers, especially since the Inland Waterways Corporation is an activity of the United States Government, undertaken in 1924 and financed with federal funds as an experiment to determine the economy of transportation on the larger streams of the country in comparison with the costs on other agencies, principally the railways, already available.

"Net Income"

Let us look first at the reported net income of the Inland Waterways Corporation. Of the total of $253,-935, one notes at once that $127,468 was derived from bond interest on $4,437,000 surplus capital invested in government bonds. This surplus capital is money appropriated by the government for the Waterways Corporation in excess of its present needs for equipment and facilities. By investing this surplus in government bonds, the Waterways Corporation is taking to its credit as operating income the interest earned by these bonds, while the taxpayer is left to foot the bill for the original appropriation. It is in this manner that the corporation secured more than half its "net income."

If this sum be deducted, $126,467 is left as the return on an investment in physical equipment of a depreciated book value of $18,601,154, a return of only one-fourth of that received on the corporation's investment of less than 25 per cent of that amount in government bonds. On that basis, the corporation would have shown far greater profits if all of its funds had been invested in bonds rather than in barges, tow boats and other equipment.

This report also shows $82,333 of expenses which a private corporation would have to pay out of its income were paid out of the government treasury. These expenses were for officers' salaries, rents, postage, etc. If these costs were added to the expenses of the corporation, the "net income" would be still further reduced to this extent. It is evident, therefore, that more than 83 per cent of the "net income" of the Waterways Corporation last year was not earned by barge line operations at all but actually came from the government treasury.

Savings to Shippers

Let us turn now to the claim that the Inland Waterways Corporation saved the shippers of the country $2,215,000 last year. This claim is based on the difference between the total amount paid by shippers for the transportation on the river of the freight actually moved and the amount they would have paid for the movement of this tonnage by rail. Like previous claims made by waterway advocates, this statement ignores the cost to the taxpayers of all expenditures made for the maintenance and operation of locks and dams, and for the operation and maintenance of snag boats and dredges necessary to keep the river channels open for navigation. And no consideration is given to the earning of a return on the investment already made in the dams and other channel maintenance facilities, which investment runs into a large sum.

As an indication of the magnitude of these additional costs, let us turn to the Ohio river where figures are more readily available. The government opened that stream to navigation in 1929, after spending approximately $150,000,000 on its improvement. Since that time expenditures for maintenance and operation of these aids for navigation have averaged $3,600 a mile. On the Missouri river, these costs approximate the same amount. And when the present extensive program of lock and dam construction on the Upper Mississippi is finished, there is no reason to expect that these costs will be lower here.

These costs are just as much a part of the expense of waterway navigation as the expense of track upkeep is for the railways. Without it the barges could not operate. The only difference is that the railways are required to include these costs in their operating expenses and secure reimbursement through the rates they charge the shipper while the waterways ignore them and pass them on to the taxpayer. If and when these charges are assessed against the traffic benefited, the rates for such transportation will be increased so largely as to make the waterways no longer attractive to those who now use them at the taxpayers' expense, for these "sav-

ings" to the shippers will be wiped out several times over.

Thus, it is evident that, when all pertinent facts are considered, the Inland Waterways Corporation neither earned a net income from its waterway operations of a quarter million dollars last year, nor saved the shippers two million dollars, except through passing a large part of the cost on to the public at large. This is the nature of the "experiment" which the government is conducting in competition with the railways. The results deserve wide dissemination in order that the public may appreciate the full story of what is happening. It is to the interest of every railway employee that these facts be made known.

Water Service Employees—

Important Cogs in Rail Transportation

OF all the maintenance of way and structures employees on the railways, possibly the least heard from or about are those in the water service department. This is a situation which is not at all in keeping with the importance of this department, either from the standpoint of the large expenditures made by this department, or from that of its important contributions to the improvements which have been made in train operation.

It has been estimated by the Water Service Committee of the American Railway Engineering Association that the aggregate purchases made by the railways of the country in connection with the maintenance, operation and improvements of their water services exceed $19,000,000 a year, including $1,600,000 for pumps, $950,000 for power units, $2,500,000 for water tanks, $600,000 for water columns, $3,200,000 for cast iron pipe, $1,500,000 for wrought iron and steel pipe, $790,000 for valves, $6,700,000 for chemicals for water treatment, $169,000 for hydrants and accessories, and approximately $1,100,000 for rubber products. During 1936, according to figures compiled by the Interstate Commerce Commission from reports compiled by individual roads, the operating expenses of the Class 1 roads of the United States included $5,860,164 for the maintenance of water stations, $15,900,521 for water for train locomotives, and $3,326,531 for water for yard locomotives—a total of $25,087,216. From these figures, with the large responsibility for directing and making expenditures which is involved, it is evident that the water service employee is and should feel himself a highly important factor in the business of rail transportation. But beyond this, and of still greater importance, is his value in effecting economies in train operation and in making possible the improved passenger and freight service which is now being offered by the railways.

Under the direction of its water service employees, the railways have come a long way in the matter of providing suitable locomotive boiler water, as the result of which they are saving millions of dollars annually in locomotive maintenance and train operating costs. A few years ago, a large eastern road which had been giving major consideration to the quality of its water supply and the most economical methods of handling it, estimated that it was removing aprpoximately 28,700 lb. of incrusting solids and mud daily from its locomotive boiler water and thereby effecting an annual saving of more than a $1,000,000. On one division of the road alone it was established definitely that the savings effected in a year of normal operations exceeded by at least one-quarter the total capital investment in the treating plants on that division.

The savings that are being made on this road, while exceptionally large because of the volume of water used and the careful consideration given to its treatment, are typical of the large savings that are being made by many other roads. These savings are being effected primarily as the result of extending and improving methods of water treatment, and the modernizing of water pumping equipment. Wherever suitable water treatment has been made available, locomotive boiler maintenance costs have been reduced materially. At the same time, through fewer locomotive shoppings for boiler washings and boiler and firebox repairs, the availability of locomotives for road service has been largely increased. It is a fact also, that many of the long engine runs in vogue on the railways today were made possible only as the result of improved boiler water, which has precluded the otherwise necessity for boiler washing and repairs at frequent intervals.

Wherever improvements in the character or method of delivery of boiler water have been made, the economies resulting therefrom have been large. The Committee on Water Service of the A.R.E.A., in 1913, placed a saving of 7 cents a pound on scaling solids removed, and later, in 1924, increased this to 13 cents to correspond with increased maintenance and operating costs as of that date. Even in the face of this latter estimate of saving per pound, which is now thought by some to be too conservative as the result of the larger power and increased maintenance and operating costs of the present day, it is readily evident that the savings resulting to the railways annually through the activities of their water service departments run into many millions of dollars. Add to this the value of water treatment in the matter of fuel saving, and its importance in making possible the economies being effected through increased locomotive utilization and long engine runs, and one begins to get a true picture of the important part which is being played by water service employees in the matter of increased railroad efficiency.

It is true that the end has not been reached, and that there still remains a large field for further economies through improved water service practices on the railways. This is evidenced clearly in the fact that an estimated 2,000,000,000 gallons of boiler feed water is still being used by the railways annually without treatment of any kind. In fact, the Water Service committee of the A.R.E.A. estimates that $12,000,000 can be saved annually by the elimination, through proper treatment, of corrosion in locomotive boilers alone, and that a still large amount can be saved through the elimination of scaling solids in boiler feed water.

From the foregoing there should be no question of the important place of the water service employee in the field of rail transportation. And it is equally evident that he can become a still more important cog as he promotes the further large economies that are possible through the increased use of properly-treated water and modern methods for handling it at minimum cost.

Switch Ties

Renewed in Sets or by Spotting?

NO more interesting example of the changes that have taken or are taking place in maintenance practices can be cited than that of renewing switch ties. A generation ago, a canvass of supervisory officers would have brought unanimous response that complete renewal of the ties through turnouts was desirable. Yet, while the response to a similar canvass today might be expected to lack unanimity, the majority would favor spot renewals.

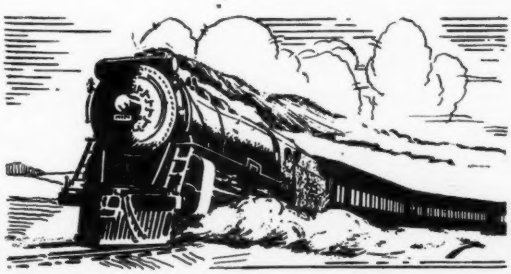
This change in viewpoint has been brought about by several factors, not the least of which is wood preservation. Thirty-five years ago, the preservative treatment of switch timber was practically unthought of by maintenance officers. At that time white oak was the only wood that was considered suitable for switch ties in most sections of the country, not only because of its long life, but also because of its ability to resist widening of the gage and rail cutting, compared with other woods.

While the supply of white oak has by no means been exhausted, prices have advanced to such an extent that it is no longer economical for switch ties. For this reason, the railways have turned to other woods, principally red oak, southern pine and Douglas fir. But as these woods are not highly resistant to decay, it has been necessary to subject them to preservative treatment, with the result that, if they are given proper care, they will last longer than the untreated white oak.

Even with the same species of wood, cut in the same locality, seasoned under identical conditions and treated in the same charge, there will be considerable variation in the useful life of the individual ties in a set of switch ties. If the individual members of the set come from scattered points and they are not seasoned and treated under the same conditions, this variation may be still more pronounced.

For these reasons, there is no more justification for renewing an entire set of switch ties than for renewing ties out of face in a main track. In other words, to do so will be to waste both labor and materials, for experience has shown that more useful life can be obtained from switch timber if it is allowed to remain undisturbed in its original position until it is ready for replacement. When taken out and used for patching at less important turnouts, its remaining life is shortened definitely.

In addition to those considerations, spot renewals keep the general condition of the set permanently at a higher level. In out-of-face renewals there are periods when the condition of the turnout is well below normal. There is always a tendency to allow the set to remain undisturbed until the majority of the ties are ready for replacement. Even then, some timber is wasted, since the service life of some of the ties is far greater than the average. Again, if they are used for patching elsewhere, the cost of handling and installing them in other turnouts will generally be greater than the value of the remaining service life of these ties in their new locations.



Brick Walls

What is the Secret of Water-Tightness?

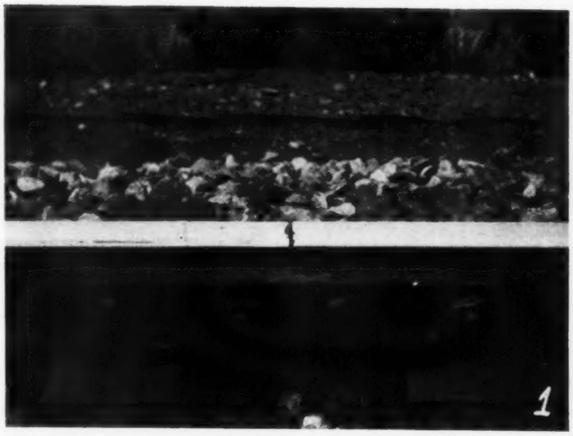
THE art of brick masonry construction is so old that there would appear to be little chance for dispute about best practices in it. Yet, the fact that there is a quite general difference of opinion concerning certain features of such construction, and especially as regards the character of the mortar to be used, is clearly evident in the article in this issue by Howard R. Staley, entitled, "Leaky Brick Walls, Why They Occur—How to Prevent Them." The fundamental conclusion presented in this article is that lime is essential to a good mortar and water-tight walls.

The use of lime in brick mortar is not new. Indeed, for centuries before portland cement was developed, lime had been used as mortar. And for all of these years it produced what were classed as enduring structures. With the development of portland cement, with its strength-giving qualities, the value of this material in mortar became evident, and its use was rapidly adopted, either alone or with a percentage of lime. In fact, with over-emphasis upon bond and load-carrying strength, there developed an increased tendency to minimize the lime content, even at the sacrifice of workability and intimacy of bond which every mason knows are increased by the use of lime. It is this tendency, still continued to a large extent, that is frowned upon in the paper referred to, especially where water-tightness in walls is an important factor. Both the field and laboratory tests reported upon indicate that in most cases high strengths in mortars produced by low-lime content are not conducive to intimacy of contact or to extent and permanence of bond so necessary for water-tight walls. On the other hand, they indicate that while the high-lime mortars have less strength in themselves than high-cement mortars, they have greater plasticity, greater ability to gain intimacy of contact, and autogenous healing properties—all of which are conducive to water-tight walls.

The facts brought out in the paper may have little bearing upon the practices in brick masonry construction on most railways because it is still common practice on most roads to use a sizable percentage of lime in mortar for brick work, if only because of the greater workability which is secured. The paper will be of particular interest, however, to those who have been troubled with leaky walls, and in acquainting railway building men generally with the character and extent of the bond produced by various types of mortar, which only the insight of laboratory research can disclose.

Building-Up Rail Ends

The Pennsylvania, which yearly reconditions many thousands of battered rail ends by both the electric-arc and the oxy-acetylene methods, and also by grinding exclusively, has for the last four years been employing two- and three-flame gas torches extensively with the aim of speeding up the work and of minimizing the penetration of weld heat into the rail head. This article discusses the use which has been made of these types of torches and, so far as is possible from records available, points out the results being attained.



1—Chipped and Battered Rail Ends, Marked for Welding. 2—Pre-heating the Rail Ends. 3—Making the Weld With the Carriage - Mounted, Three-Flame Torch

THE reconditioning of battered rail ends by gas and arc welding, and also by grinding, is now a practice of long standing on the Pennsylvania, having been started by that road on a sizeable scale as early as 1918. However, there is one phase of the welding work now being done by this road concerning which little has been said. This is the use of two- and three-flame oxy-acetylene welding torches. At the present time, following several years' experience, these torches have largely replaced the single-flame torch and are said to be doing highly satisfactory work, with a substantial saving in cost.

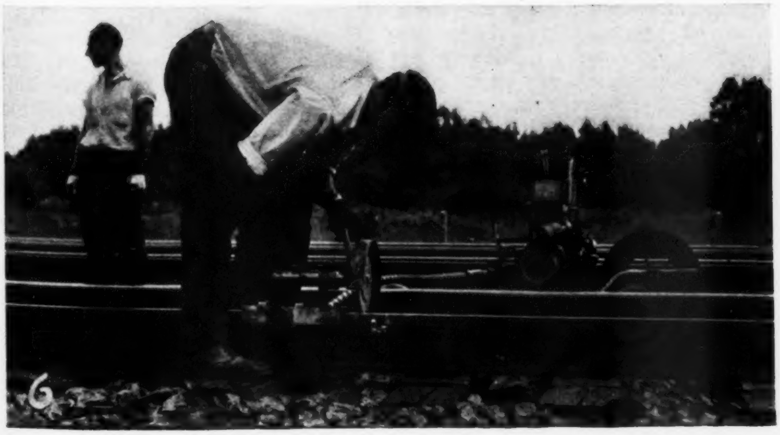
At the present time, more than 100 two-flame torches and approximately 50 three-flame torches are being used by regional gangs which move from division to division building up rail ends out-of-face in accordance with carefully prepared programs. The extent of the work done with these torches is seen in the fact that 112,495 joints, involving approximately 550 track miles, were built up by oxy-acetylene welding in 1937, largely with the two-flame and three-flame torches.

The Two-Flame Torch

In discussing the repair of battered rail ends on the Pennsylvania, it should be made clear at the outset that this work is not confined to the

With Multiple-Flame Torches

4—Peening the Weld. 5—Surface Grinding the Built-Up Ends, Employing Flexible Shaft, Cup-Wheel Grinders. 6—Slotting Is Limited to a Depth of 3/16 in.



use of multiple-flame torches, or exclusively to gas welding. As a matter of fact, in addition to the 112,495 joints built up by gas welding in 1937, a total of 87,617 joints were built up by electric arc welding, and thousands of additional joints were restored to good riding condition by the expedient of grinding, without the addition of any metal whatever. However, interesting and effective as is each of these various methods, this article will deal primarily with the latest development in the work, involving the multiple-flame torches.

The development and use of multiple-flame welding torches on the Pennsylvania was brought about by the desire to increase the speed of accomplishing the work (economy), and the further desire to minimize the depth of heat penetration into the rail. The two-flame torch has two welding tips placed side by side, which are joined to a common gas distributing chamber, the inlet of which is attached to the gas mixing head of the welding torch. The tips are set on extended radial lines of the average rail-head curvature, so that the center of each flame strikes the head of the rail normal to the surface at the point of contact, and thus tends to prevent the loss of heat by deflection. In the use of the two-flame torch, it was found advisable to employ a combination of two cylinders of acetylene and one cylinder of oxygen, rather than one cylinder of each, and this practice has been continued, bringing about a more efficient and complete use of the gases.

The Three-Flame Torch

For use with the two-flame torch, with its flame practically double the width of that produced by the single-flame torch, a welding rod ¾ in. wide by ⅛ in. thick and 36 in. long was developed. Later, the thickness of the rod was reduced to 1/16 in. Worked on its flat side, in the path of the wide flame, this rod breaks down readily and fuses quickly with the surface of the parent metal of the rail head.

Encouraged by the results obtained with this combination of torch and rod, and in an attempt to secure even greater speed of operation and more uniform results with still less heat penetration into the rail, the three-flame torch was developed. In this torch, which was described in *Railway Engineering and Maintenance* for June, 1935, the tips, which are spaced 7/8 in. center to center, are also arranged to lie on extended radial lines from the curved surface of the rail head, and thus further minimize deflection of heat from the rail. As in the case with the two-flame torch, the three tips are connected into a common gas distribution chamber, which, in turn, is joined to the mixing head of the torch. To insure the holding of the torch at the most effective distance from the rail while welding, and at the same time insure even application of the heat, the torch as a whole is mounted rigidly on a carriage, which not only permits its movement in line with the rail, but also laterally across the rail head. This unit of equipment was also described in the earlier issue of *Railway Engineering and Maintenance* already referred to.

A Weld Made With a Three-Flame Torch, Prior to Surface Grinding and Slotting

To secure the most efficient and complete use of the gases with the three-flame torch, it is fed by a battery of three cylinders of acetylene and one of oxygen, the acetylene cylinders being tapped as a unit through a four-way manifold. The rod employed with this torch is 1 5/8 in. wide, 1/16 in. thick and 36 in. long, presenting a broad surface to the wide flame, which is broken down rapidly and uniformly over practically the full width of the rail head.

Instructions Govern Work

According to written instructions covering the building up of battered rail ends on the Pennsylvania, all ends with less than 1/64 in. (0.016) batter are leveled off by grinding. Where the batter ranges from 1/64 in. (0.016) to 1/16 in. (0.063), the ends are built up by welding, which is also allowed where the batter exceeds 1/16 in., except that where more than 1/16. in. of metal must be added, consideration is given to cropping the rail ends. No attempt is made to build up rails with end batter in excess of 1/8 in. (0.125), such rails being cropped for further use in secondary tracks.

No welding is permitted to extend further than 10 in. from the end of a rail, and welds must not extend laterally beyond the junction of the head surface curve and the fillet curves at the sides. Under no conditions is heating of the rail permitted outside of these limits, and any attempt to reform the head of the rail in connection with welding operations is prohibited.

Prior to all rail-end welding on the Pennsylvania, the track is gone over by the track forces to insure that, so far as the ballast, ties, bars, surface and bolt conditions are concerned, the joints are in good condition, thus avoiding the application of excessive weld metal because of conditions other than true batter. Instructions in this regard require that all joint ties must be tamped thoroughly and the rail brought up to true surface, and that the joint bars must fit snugly throughout their lengths, with sufficient take-up space between their inner sides and the webs of the rails. If the inner sides of the bars at the top contact the webs of the rails or lie too close to allow proper drawing-up space over a reasonable period of time, or if the bars do not fit closely at the top through the center, it is required that they be replaced with reformed, oversize bars. Other instructions for the conditioning of joints preliminary to the building up of rail ends require that the ballast at joints must be cleaned if necessary, that ties must be renewed where unsound, and that all bolts must be tightened or renewed, as necessary, to secure proper tightness.

Before proceeding to build up rail ends, it is required that all surfaces to be welded must be clean and free from grease or oil, and that where laminations, oxidized metal or cracks exist under the rail head surface, which cannot be removed completely by the use of a wire brush or a chisel, the unsound metal must be washed out with the welding torch before any new metal is applied. This same requirement holds in the case of chipped or spalled rail ends, where it is required that clean parent metal must be exposed before any additional metal is added.

In the actual welding operation with the multiple-flame torches, the depositing of the metal is begun at the end of the rail and is continued progressively to the run-out of the weld with the normal surface of the rail. In this operation, the rail end within the limits of the required weld is first preheated with the flame to a cherry red, which usually requires from 30 to 45 seconds. When at the proper heat, the rod is inserted under the flame, flatwise on the rail head. As the rod metal is deposited, it is puddled in with the molten parent metal of the head, this process being continued progressively forward to the limit of the weld. Throughout the length of the weld, the added metal is peened at intervals with a four-pound ball peening hammer to increase its density and to produce a level surface across its top.

While making a weld, both the flame and the rod are moved crosswise of the rail as necessary to cover the full surface of the head. Following the completion of the welds, they are allowed to cool under atmospheric temperature.

The rod used in the welding, which is an unannealed ribbon wire, lime-coated and mill finished, has the following chemical analysis:

Carbon	0.95 to 1.10
Manganese	0.45 to 0.65
Phosphorus	0.03 maximum
Sulphur	0.03 "
Silicon	0.20 "

This rod produces a weld with a Brinell approximately 50 points above that of the adjacent normal rail steel.

Limited Penetration of Heat

One of the important advantages claimed for the multiple-flame torch is its ability to preheat the rail and to deposit the rod metal rapidly, thus limiting the depth of heat penetration into the rail head. At the same time, however, it is recognized that this very factor imposes added responsibility upon the welder, who can readily bring about deep penetration of the heat in the rail, and actually burn the metal by over-application of the torch.

The matter of limited heat penetration is considered of vital importance by the Pennsylvania, so much so that it is definitely specified that the heat penetration must not extend more than one half the depth of the rail head.

To insure control in this regard, the instructions issued to welders specify that the time required to build up the entire rail head throughout the length of the weld must not exceed four minutes. If the depth and length of the weld are such as to require additional time for the application of the metal, which is seldom the case, the welder must stop welding at the end of four minutes and allow the rail head to cool before adding more metal.

Experience has shown repeatedly that, using either the two- or three-flame torch, 1/16-in. batter extending over a distance of as much as 7½ in. can be built up by an experienced welder within the time limit specified, and that penetration of heat into the rail head can be limited to a depth of ½ in. without difficulty where reasonable care and skill are employed. So far as uniformity of heating of the rail is concerned, the carriage holder of the three-flame torch, which maintains a constant and proper relationship between the tips and the rail head, should have an advantage over either the single-flame or double-flame torch, both of which are held by hand. However, it is recognized that this factor offers no safeguard against lack of uniformity in the movement of the flames longitudinally along the rail head, which, of course, could bring about equally as bad lack of uniformity of heating as variation in the distance between the torch tips and the rail surface in the case of torches held by hand.

Welding Organization

The rail-end welding work on the Pennsylvania, as before mentioned, is done by regional gangs equipped with camp-car outfits, which move from place to place in accordance with carefully prepared programs. The welding gangs usually include four or five welders with the necessary equipment to keep them busy; a lead welder, who marks the limits of the welds to be made and supervises the welding operations; two or more trackmen helpers, who move the gas cylinders as necessary and assist the welders; two or three grinder operators, whose work will be mentioned later; and two or more flagmen. On the high-speed electrified territory between New York City and Washington, D. C., where the speed and the quiet operation of electric trains add to the hazard of the work, each welder is given a trackman helper, whose principal duty is to act as a watchman. These men are required to face the direction of traffic, and are not permitted to leave the welders for any reason while they are at work.

In carrying out the welding, each welder builds up the joints in both lines of rails as he moves forward, and has enough hose to enable him to complete 9 to 12 welds with each setting of the gas cylinders. To utilize the time of the welders most effectively, the trackmen helpers, while not acting as watchmen, keep the gas cylinders moved ahead and coupled up, so that there is minimum delay to the actual welding operations in this respect. For the same reason, the cylinders are moved ahead each night and are set up so that the welders can start promptly when they arrive on the work in the morning.

Production

The daily production of the welding gangs on the different divisions has varied widely as the result of variations in the number of hours worked, weather conditions, traffic delays and other factors, records showing that the number of joints completed by the four-welder gangs has ranged from as few as 80 to as many as 140 in an 8-hour day. That delays of an unavoidable character have an important bearing upon the amount of work done, is seen in the fact that these delays in many cases have consumed as much as 40 per cent of the working time, and seldom are less than 25 to 30 per cent.

With so many variable factors affecting the daily production, it is impossible to arrive at any truly representative figure of the time required or the actual cost per weld for the three types of torches. The wide variation in the length of welds necessary on different sections of track also adds to the difficulty of arriving at any specific figures. As regards gas welding on the road generally, however, analysis of the production figures for 1937, covering the 112,495 joints repaired, indicates that it required from 10 to 15 min. of the welders actual working time per joint, this time including that for moving from joint to joint and all auxiliary operations in connection with the welding, but not delays due to traffic, weather, or other factors beyond the control of the welding forces.

A more detailed analysis of the work done over a period by four, four-welder gangs at five locations on four different divisions, involving a total of 10,437 welds (both rail ends at a joint), shows that the average time required per weld, excluding unavoidable delays, was 12.9 min. In these welds, the depth of batter ranged from 0.013 in. to 0.020 in.; the average length of weld on the leaving rail was 2½ in., and on the receiving rail 5 in.; and the average amount of metal applied per joint was 0.2 lb.

The above computed average time per weld, representing as it does the use of all three types of torches, gives no indication of the relative speed with which welds can be made with the different torches. However, it is said that repeated timing of individual welds has shown that welds can be made approximately twice as fast with the two-flame torch as with the single-flame torch, and that a still further substantial saving in time is made where the three-flame torch is used. An offsetting factor to this advantage of speed with the multiple-flame torches is a certain amount of resistance to their use by many welders because of the more exacting attention required in their proper use, and the increased amount of heat involved, which becomes objectionable to many of the men on hot days, especially with the three-flame torch, in spite of the fact that the carriage holding this torch provides special guards to deflect the heat toward the rail and away from the welder.

A Completed Three-Flame Torch Weld—Note the Indication of Shallow Heat Penetration in the Head

As regards the character of the welds possible with the multiple-flame torches, there appears to be little question, assuming, of course, intelligent, interested use of the torches. Examination of hundreds of welds made with these torches shows clearly that objectionable heat penetration in the rail head can be limited to a depth not exceeding ½ in., and that the welds are sound and durable. As a matter of fact, it is pointed out that a defective weld made with either a two- or three-flame torch is still to be reported, even though many thousands of the welds have been in service under the heavy main-line traffic be-

(Continued on page 483)

Leaky Brick Walls

Why They Occur—

How to Prevent Them

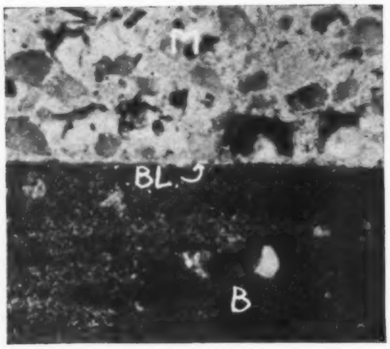


Fig. 1—Reflected Light Mag. 20X—Age 21 yr.

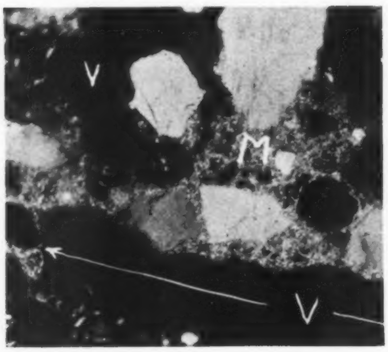


Fig. 2—Transmitted Light Crossed Nicols Mag. 60X—Age 21 yr.

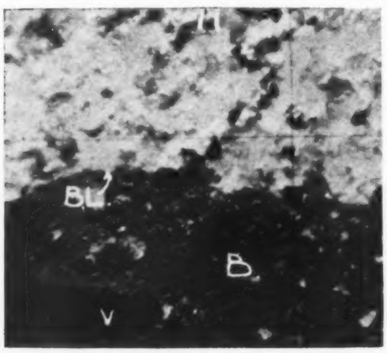


Fig. 3—Reflected Light Mag. 20X—Age 37 yr.

By HOWARD R. STALEY

Research Assistant, Department of Building Construction and Engineering, Massachusetts Institute of Technology

IN MOST of the investigations of the leaky wall problem, bond strength between the brick and mortar has been given much consideration. This problem cannot be solved on the basis of bond strength alone. A certain amount of strength must be sacrificed for other most desirable and necessary qualities in a mortar. Professor W. C. Voss of the Massachusetts Institute of Technology has made extensive studies of this problem, both in laboratory research and in subsequent corroboration in the field. He maintains that the extent and permanence of the bond should be given primary consideration.

In addition to other studies, Professor Voss introduced the microscopic study of thin sections of the test specimen. In carrying forward this study, authenticated specimens were obtained from widely separated localities and of many ages and combinations of materials. Thin sections were made from these specimens for scientific study. The use of the microscope provides the only simple means whereby the characteristics of the bond between brick and mortar in existing walls can be studied. From this type of study, definite conclusions can be drawn as to the factors which produced existing conditions.

The photomicrographs and surface pictures reproduced herewith are typical of the specimens collected and are representative of materials from the larger part of the United States. The letter V superimposed on the pictures is used to indicate voids or holes. The brick line is marked B.L., mortar M, and brick B. Cracks are marked C.

Figure 1 is a surface picture of an excellent high-cement mortar with a roughly cut surface. Apparently there is a continuous and intimate contact between the mortar and the brick surface. Sand gradation seems to be very good, which is an important factor with any kind of mortar. This wall leaked, but not badly.

Figure 2 is from a thin section of the same mortar and brick as Fig. 1. This shows that there has been considerable water passage through the voids at the brick line. The extent of hydration and carbonation showing in the highly birefringent area (light colored area of the matrix) over and to the left of the large void at the brick line, indicates that ample water was available. Note that the area surrounding the round void in the upper left does not show the same birefringence. It is logical to presume that this is a sealed void and that no water has been available for accelerated hydration and carbonation.

Figure 3 shows a 1-cement, 2-lime and 7-sand mortar which exhibits good contact in spite of a rough brick surface. The texture of the surface of the mortar appears much rougher than that of Fig. 1, owing to the fact that these sections were roughly cut with a carborundum wheel.

Figure 4 is another surface picture of the preceding specimen, taken at the juncture of the old high-lime mortar and the new high-cement pointing mortar, which was about ⅜ in. deep. The old high-lime mortar, marked O.M., still retains the same intimate contact, while the high-cement mortar, marked P.M., has cracked entirely loose from the brick. A line of water-deposited dirt was

*Abstract from a paper entitled "A Petrographic Study of the Bond Between Brick and Mortar," which appeared in Bulletin No. 396 of the American Railway Engineering Association.

This monograph, based upon extensive investigation by Walter C. Voss, professor of building construction, Massachusetts Institute of Technology, and the author, deals with the bond between brick and mortar, and, more particularly, with the type of mortar which will produce the most satisfactory wall. The fundamental conclusion presented is that lime is essential to good mortar, producing increased plasticity, better workmanship, greater intimacy of contact or bond, greater resistance to volume change stresses, and withal, increase watertightness in a wall.

quite evident at the juncture of the pointing and the old mortar, indicating that water had penetrated past the pointing only. This is a striking example of how different these two mortars are in physical properties and action in a wall.

Figure 5 was taken from a thin section of the old mortar area of the preceding specimen. Note the intimacy of contact with a very rough brick surface. It is very evident that this mortar had the plasticity necessary to give the intimacy of contact needed for continuity of bond. There are some voids, but there has been only a slight amount of accelerated carbonation. This has occurred in the voids at the brick line, indicating that some water has been available there, but in a very small quantity. Note the arching action of the sand grains, marked "S", over the void at the brick line, showing poor sand gradation.

Figure 6, a surface picture, is a good illustration of what is meant by tentacular contact, as exhibited by a high-cement mortar. It is impossible in this type of picture to show the depth of these holes, but ample evidence is at hand to substantiate the theory that there are many other voids like this, not visible on this surface, which are interconnected and provide a passageway for water. The conditions under which this wall was erected are known to the author personally. A definite attempt was made to do a first class job on this wall and workmanship was of the best. The wall leaks now and, in all probability, will continue to leak more as it gets older.

In Fig. 7, which is a picture of a thin section made from a specimen from the same wall, note the crack at the interface marked C. This crack will eventually extend over to the larger voids at the left. Here is evidence that this type of high-cement mortar does cause disruption of bond. With the nicols crossed (double polerized light), the area of the matrix over the crack is highly birefringent, indicating advanced hydration and carbonation due to leakage. There are many unhydrated cores of cement grains showing in this picture, a condition which is representative of the whole section.

The type of void shown in Fig. 8 is typical of those voids close to the brick line in the mortar of the preceding specimen. A black mineral base color was used in this mortar, which masks some of the birefringence in the matrix. Therefore, it is logical to assume that this highly birefringent fringe of crystals around this void was deposited after the matrix had reached a state of final set, and that these crystals were able to form because of the continued availability of water. In view of the fact that these are calcium carbonate crystals, it is logical to assume that if the matrix surrounding the voids contained more lime, (the only lime available being that resulting from the hydration of the cement), these voids would eventually be filled with crystals of calcium carbonate.

Sand Gradation

The sand in the area from which the next specimen, Fig. 9 (surface picture) was taken has a very poor gradation and even the lime mortar here, which is a 1-cement, 1-lime, 6-sand mortar, appears harsh. However, it will be noted that the voids are fewer and the contact with the brick is much better in this specimen than in the case of the cement mortar in Fig. 10.

Figure 10, a surface picture, was taken from a wall which leaked very badly and which was laid up with a 1-cement, 2½-sand mortar. Some evidence of segregation is shown in this picture, in spite of the rich mixture. The sand grain marked L.S. is entirely loose from the matrix. Undoubtedly, segregation in a mortar is the cause for harshness in working under the trowel. Figure 10, with its high-cement mortar, also shows disruption of bond.

Two definite conclusions can be drawn from Fig. 11, which are substantiated by a study of several sections of this specimen. The first—cracking occurs at or near the brick line with high-cement mortars, and the second—water penetrates at or near the brick line. Note the crack at the brick line, marked C, under the

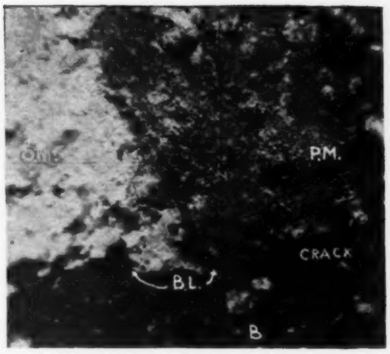


Fig. 4—Reflected Light Mag. 15X—Age 37 yr.

Fig. 5—Transmitted Light Crossed Nicols Mag. 60X—Age 37 yr.

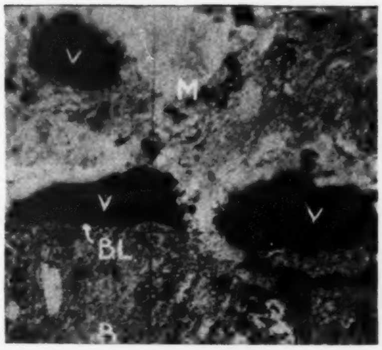


Fig. 6—Reflected Light Mag. 20X—Age 11 yr.

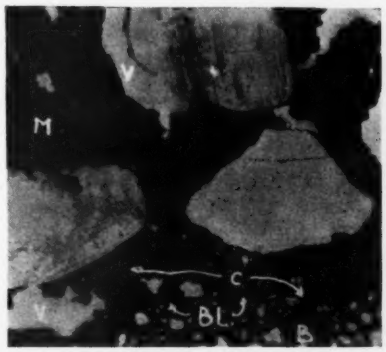


Fig. 7—Transmitted Ordinary Light Mag. 60X—Age 11 yr.

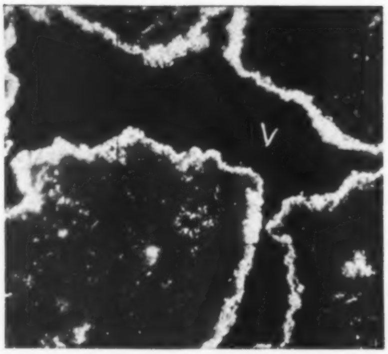


Fig. 8—Transmitted Light Crossed Nicols 280X—Age 11 yr.

large sand grain in the center of the field. This will eventually extend into the large void at the left, making water passage easier. The extent of hydration and carbonation in the areas marked H is shown by the high birefringence in these localities. Since it is known that the wall leaked badly, the water must have penetrated through the areas where hydration is farthest advanced.

In Fig. 12 is shown a very good mortar contact with a very irregular brick surface. The proportions of this mortar are 1-cement, 2-lime, 9-sand. As stated before, these surfaces are rough-cut, which accounts for some of the coarse looking texture. In order to gain the intimacy and continuity of contact with a brick surface as rough as this, a mortar must be a very plastic high-lime mortar. It must be a high-lime mortar for two reasons: (1) To gain intimacy of contact when being laid, and (2) to benefit from the densification and filling of small voids at and near the brick line due to the suction of the brick. Lime is the only material known to the author which will impart to mortar the properties necessary for this type of contact. To insure against leakage, such contact is essential, not only when first laid, but at a later date when the stresses produced by volume changes, etc., have exerted their efforts.

Lime Required

In most cases the requisites for high strength in mortars are not conducive to intimacy of contact, nor to extent and permanence of bond so necessary for water-tight walls. The highest strength mortars generally are harsh-working and do not possess the plasticity necessary for full and complete contact. Such mortars, usually of a high-cement content, make it impossible to secure a water-tight wall.

A statement has been made by an advocate of high-cement mortars that workmanship is 95 per cent of the job. It is agreed that workmanship is of high importance, but the class of workmanship and the water-tightness of a masonry wall depend 95 per cent upon the type of mortar used. This latter statement is not the result of laboratory work in an educational institution, but rather is the result of laboratory work in the school of "hard-knocks," where practical ex-

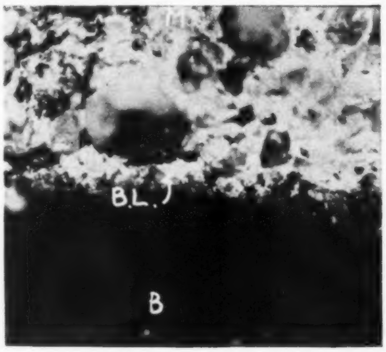


Fig. 9—Reflected Light Mag. 20X—Age 5 yr.

perience is a prerequisite in the curriculum. Mortar must have plasticity and workability to enable a workman to do a good job.

Plasticity and the ability to gain intimacy of contact are the essentials of a good masonry mortar. They go hand in hand, and without one the other is lost. The mortar which can be worked and placed with the least amount of effort on the part of the mason, and which has the ability to withstand repeated stresses without rupture of bond, is the mortar which will produce best results. High-lime mortars fulfill these qualifications. Without the plasticity and the autogenous healing properties that lime imparts to mortar, the chances for a water-tight wall and one that will remain water-tight over a period of years, are slight. Low-lime or high-cement mortars do not fulfill the required qualifications, as they are generally harsh-working and cannot withstand subsequent volume change and other stresses without rupture of bond.

High-cement mortars, due to their inherent strength and rigidity, tend to break at the juncture of the brick and mortar when subjected to these later stresses, as the contact between the two is tentacular or spotty, forming a plane of least resistance to stress. High-lime mortars, due to their intimacy and extent of contact with the brick, and to the lower inherent strength of the mortar body, tend to maintain the bond and break in the body of the mortar, which presents the least resistance to stress in this case. The chance for autogenous healing of a rupture such as the latter, is infinitely greater in the high-lime mortar.

Brick Suction

Another factor enters when intimacy of contact is considered. This is the suction of the brick. Some suction is necessary as the phenomenon of bond is largely a mechanical union between the brick and mortar. When a brick is laid in a high-lime mortar, the suction of the brick tends to densify and fill voids in the mortar at the interfacial layer or brick line. Lime particles which are in solution and suspension in the mixing water are carried to the surface of the brick and are there deposited, leaving a layer of crystals at this plane which will carbonate and increase the strength and extent of the

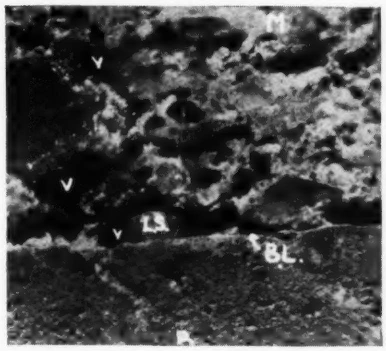


Fig. 10—Reflected Light Mag. 20X—Age 9 yr.

bond. The harsher working high-cement mortars do not possess the fatness necessary to gain full benefit from the suction of the brick, since they are non-plastic and are not in intimate contact originally; neither do they have the lime available in sufficient amount. The result is a tentacular contact by fingers of mortar adhering to the brick. The center portion of the cement mortar joint remains the most dense, leaving the greatest number of voids at the interface, for the easy passage of water.

With a very dense brick, water voids will form at the junction of the brick and mortar with any type of mortar. The percentage of these voids will be much higher with a harsh-working, low-lime mortar because the water excess is greater in this type of mortar. Tapping the brick in place tends to concentrate the water at the plane of the brick. With a brick of medium absorption, the high-lime mortar is benefited by den-

sification and void filling at or near the brick line. With a highly absorptive brick, the high-lime mortars are harmed the least by the large water loss, and the high-cement mortars suffer because of loss of water needed for the proper hydration of the cement.

The porosity of any mortar is increased when used with a highly absorptive brick. Almost at once, with a large loss of water, the mortar attains a rigidity far beyond that caused by the state of hydration or carbonation, and the beneficial act of consolidation cannot take place to as great an extent. With the use of a medium-absorptive brick, high-lime mortar remains in a plastic state for a longer period than a high-cement mortar. The density of the mortar must and does increase somewhat in the consolidation that takes place under the increments of load added as the wall is erected.

Volume Change

The factor, differential volume change, must be taken into consideration during this early period. The mortar is shrinking due to loss of water, and the brick is swelling, due to a gain in water. If the mortar can remain in a plastic state during this period, it will be less harmed than one which assumes early rigidity.

The volume changes which occur after the mortar has set are the most harmful to bond, especially in the high-cement mortars. Several specimens of high-cement mortars from widely separated districts exhibit the same traits; namely, high porosity and tentacular contact at the brick line, and rupture of the bond, especially towards the weather-exposed face of the joint where volume changes are the greatest.

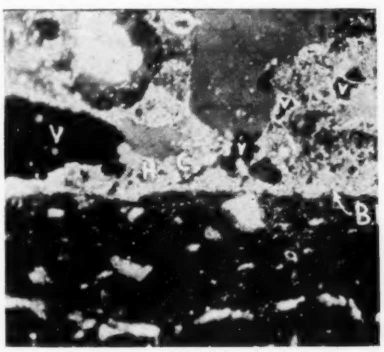


Fig. 11—Transmitted Light Crossed Nicols Mag. 60X—Age 9 yr.

Sealed voids are evidently inconsequential, provided they are not too numerous. It is the interconnected voids that cause leaks, providing a path for the entrance of water. The possibility of the voids being continuous in the body of the mortar is slight and there is always the possibility of these being plugged by the deposition of calcium carbonate, providing lime is present in sufficient quantity for this to occur. A high-lime mortar is commonly more porous in the body of the mortar itself. However, it is more or less densified at the brick line and has continuity of bond, the important factors which prohibit the entrance of water to any great extent.

With inhibition of flow of water through a lime mortar, leaching is negligible and weathering is decreased materially. Any water which enters will undoubtedly dissolve some material, but this will likely be deposited in some void as larger crystals of calcium carbonate. These larger crystals have been seen in many of the sections surrounding voids, and in portions where they have quite obviously been deposited to fill voids completely.

Leakage at Interface

Several investigators have stated that water enters between the brick and mortar, but no one, to my knowledge, has offered any definite proof of the statement. In the thin sections made from specimens taken from walls that leak, the state of hydration and of carbonation of the matrix surrounding voids at the brick line is much farther advanced, and it is quite evident from this fact that leakage has occurred at the interface. In some cases, simple inspection of the brick and mortar specimen with a hand lens gives a good indication as to the place where the passage of water has occurred.

There is one more factor in the assembly of a mortar that deserves consideration; this is the type of sand. Gradation, shape of particles, and the amount of sand present in a mortar are often the factors that determine the difference between a poor and a good mortar. Sands of poor gradation which exhibit particle interference, tend to make any type of mortar harsh and to increase its porosity. Such sands are more harmful in a high-cement mortar. Over-sanding of high-cement mortars is ruinous; workability and placeability decrease, and the tendency to tentacular contact is increased. Over-sanding of high-lime mortars produces the same effect to a less marked degree. Considering the country as a whole, a hard and fast rule of definite proportions cannot be strictly adhered to, as allowances must be made for the type of sand that is to be used. This latter observation is perhaps obvious, but it is not generally conceded.

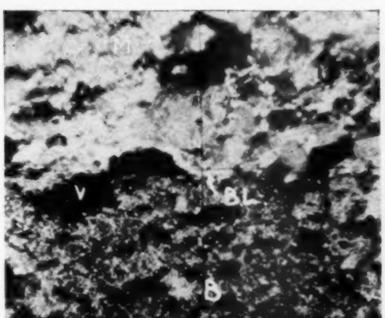


Fig. 12—Reflected Light Mag. 20X—Age 4 yr.

P.R.R. Uses Multiple-Flame Torches

(Continued from page 479)

tween New York and Philadelphia, Pa., and elsewhere on the road, for a period of nearly four years. Furthermore, examination of a large number of the earliest welds shows them still to be in a satisfactory condition.

All gas welds made on the Pennsylvania are ground to a true surface by power grinders, and to avoid chipping, all welded ends are ground flush with the original ends of the rails. Various types of surface grinders, both carriage-mounted and hand-controlled are employed in the grinding over the rail head area, while the flexible-shaft type of grinder with a ⅛-in. wheel is used primarily in the cross-cutting or slotting work.

Ordinarily, two surface grinding machines have been able to keep up with the finish grinding for a four-welder gang, although, where necessary, a third machine has been provided. Only one cross-grinder is required with the welding gangs since the actual time required to make each cross-cut is usually less than one minute.

All track welding on the Pennsylvania is carried out under the immediate direction of the chief engineers maintenance of way of the various regions, and under the general direction of Robert Faries, assistant chief engineer, maintenance, of the system, assisted by J. G. Hartley, assistant engineer. Both the two- and three-flame welding torches were developed by Mr. Hartley, with the co-operation of the Air Reduction Sales Corporation, New York.

Meeting Today's

The maintenance staff, and especially the key man in maintenance —the foreman—can do much to aid the railroads in meeting the demands of the public for greater speeds with complete safety. An abstract of an address before the Association of Maintenance of Way Foremen of the Big Four railroad.

THE traveling and shipping public of today demand much more in comfort, service and speed than was ever thought of a few years ago, and it is well for the railroad industry that this is the case. The railroads are faced by keen competition for both passenger and freight traffic and if they are to continue to exist, they must do more than meet it. They can do this only by giving better, more comfortable, faster, more convenient, more economical and more dependable service than their competitors offer and give it with a smile.

With some of these things, we in the maintenance of way department do not have much to do. We do not decide when trains shall be run but when speed is mentioned, we are concerned. No one questions that whatever speed is allowed must be safe and that the track must be maintained at all times to insure this. It is almost as important that the speed allowed be such as to insure comfort. The demand for a smooth ride is of long standing, but with the knowledge that one is traveling at high speed this becomes even more important, for if there is any sensation of lack of comfort there will be uneasiness and the idea that perhaps the speed is too great for safety. To make possible this smooth ride at today's speeds is our job.

The Foreman A Key Man

In almost every organization there is a key man or position. In the maintenance of way department we have a man, on whom, more than any other, the success of the organization rests. He is the gang foreman. You represent this great group and in speaking to you today I feel that I am speaking to the key men in the maintenance of way department.

Forces in the maintenance of way department work under different conditions than do most other organizations. In the maintenance of way department the forces are scattered and the supervising officer immediately above the foreman must work at long range, almost by remote control. This being so, he must have reliable and dependable foremen, trained and experienced, who can and will take the needed action in any emergency.

The supervising officer knows about how much rail a gang should lay, how many feet of track should be surfaced, how many ties should be renewed in a day, but there are so many unexpected demands, such unforeseen delays and difficulties developing, that the experienced supervisor knows that he cannot depend on averages, but must rely on the foreman to secure full value for the money expended. If the foreman fails, the whole organization fails. That failures have been few indicates the character and ability of the men in the key position of foreman.

The Demands of Tomorrow

What are the demands of today and tomorrow that we must meet? The call will be for even more luxury and beauty in passenger equipment, more convenient schedules and service for both passenger and freight and without question further increases in speed.

Preparing the track structure to carry trains at higher speeds is no new problem for the man responsible for maintenance of way. It has been with us ever since transportation by rail began. Along with increase in speed there has been an increase in axle load and in tonnage handled. In both speed and load the trend upward was gradual, but steady and continuous. We can all recall at least having heard of the time when 35 to 40 miles an hour was considered noteworthy. Possibly speeds of 60 miles an hour were attained 50 years ago, but such speeds were not general. Twenty-five years ago speeds of 50 to 60 miles an hour had become rather usual and for a time there was not much further increase. About 10 years ago there began a period of further increase in speed and this time it was even more noticeable in freight than in passenger service. As before, it was not revolutionary or startling, but it was uninterrupted and the gain over a period of some years was decided.

So for 100 years it has been the responsibility of the men building and maintaining the track structure to keep pace with developments in speed, weight and tonnage handled. How has it been done?

Many Developments

The track structure of today is not to be compared with the track of early days, but wherein is the change? Heavy steel rails weighing 112 lb., 131 lb. and 152 lb. to the yard instead of the light iron rail; larger ties treated to retard decay; tie plates; rail anchors and ballast of crushed stone, slag, gravel, chat or other suitable and available material instead of earth; great improvements and a high degree of refinement, but little change in basic type. These have been the development of 100 years. The constant demand for higher speed and the increase in axle load and tonnage, continually introduced new problems or revived old ones for the trackman, and these problems were solved by improved design and a higher standard of maintenance, with little change in fundamentals.

A New Period

We now seem to be at the beginning of another period of development and the advance promises to be faster and more marked than previous ones have been, particularly in passenger transportation. What we, at present, term high-speed trains in passenger service are being operated over many thousand miles of tracks. The fastest of these trains are operated at over-all schedule speeds a little over 65 miles an hour, but to average this speed they must run at speeds of 90 to 100 miles an hour at times and for considerable distances. Probably no one would dare to predict what the final requirements in track structure may be, but we have had sufficient experience to justify expressing an opinion as to what is necessary in

Demands In Maintenance

By H. R. CLARKE

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The Higher Speeds of Today Demand Greater Refinement in the Entire Track Structure

track construction and maintenance to permit these higher speeds safely.

For a number of years, trains frequently have reached speeds of 90 miles an hour and over. These speeds were not general, but were attained in selected locations where track conditions were favorable. The new schedules call for sustained high speed with no chance to pick and choose locations, so it merely becomes a problem of making all track as suitable for high speed as some track has been for a number of years, and to make possible the maintaining of high speed for long distances. This means the correction or elimination of conditions which restrict speed. To make possible long runs at high speed will require a higher standard of maintenance, a greater degree of refinement, more attention to detail, but no important change in track structure is required. This conclusion is based on the assumption that motive power and equipment will be of proper weight and design.

Curves Constitute Problem

If the problem confronting the man responsible for track maintenance was simply that of keeping track in shape for light-weight, high-speed trains, it would be easy. Even if heavy high-speed trains only were involved, it would not be hard. It becomes complicated and difficult when it is necessary, as it is and will be for a long time, to operate slow heavy trains, trains at medium speed and very fast trains on the same track. It is then that the trackman must study and weigh all factors and compromise on the methods and practices that will best and at least expense meet all the conditions involved.

Straight or tangent track is not a serious problem; it must not be neglected or overlooked, but all that is required is good line and surface. Curves are the limiting factor in allowable speed and introduce elements requiring study and adjustment. As curvature increases the difficulties multiply. The problems to be solved in the maintenance of curves are: (1) Line, including spiraling or the introduction of easement curves; (2) surface, including superelevation; (3) elevation run off, that is, the transition from level track on tangent to superelevated track on curves.

For the speeds at which we are operating today, on tangent, line, surface and gage must be almost perfect. On curves these are of even more importance and we also have superelevation and spiraling to consider. These must be a compromise adapted to trains running at various speeds on the same track. If the superelevation is less than it should be, the fast trains will ride uncomfortably and may even be derailed. If superelevation is too great, track maintenance will be increased and the heavy slow train will be retarded, especially on adverse grades. The chief engineer or engineer maintenance of way must decide what the standard superelevation shall be on each curve, all factors considered, and establish speed restrictions to fit, and the track man must then maintain this established superelevation accurately and exactly.

Curvature up to 1 deg. presents no serious problem. A 1-deg. curve with 3½-in. superelevation and about 275 ft. of spiral rides comfortably at 90 to 100 miles an hour, depending on equipment and is no serious handicap to slower trains. But as the curvature increases, the problem becomes more difficult. Based on our experience on the Burlington, a 2-deg. curve rides comfortably at 80 to 85 miles an hour, with 5-in. superelevation and a proper length of spiral; a 3-deg. curve rides well at 60 to 65 miles an hour; while on a 4-deg. curve speed should not exceed 50 to 55 miles an hour. The comfortable speed depends to some extent on the type of equipment; roller bearing, articulated equipment with a comparatively low center of gravity will ride satisfactorily at a higher speed than standard equipment on the same track.

Permissible speed is governed by the degree of curve and the amount of superelevation. The length of spiral or the distance in which the superelevation is run out is governed by the amount of superelevation and speed. It should not be more than 1¼ in. per second of rise, which means, as an example, for a speed of 85 miles an hour, superelevation should be run out at the rate of 1 in. in 100 ft., so for a curve with 5 in. of superelevation and a permissible

speed of 85 miles an hour, the elevation run off would be 500 ft. long.

If possible, the spiral or easement curve should be the same length as the distance in which the superelevation is to be run out, so that the superelevation run off will correspond with the spiral and we will have level track at the point of spiral, the superelevation gradually increasing as the curvature increases until we have full superelevation at the point of full curvature.

Sometimes it is not possible to introduce a spiral of sufficient length, without involving excessive throw of track, or because of some fixed point such as a bridge, railroad crossing, station platform, etc., and in this case part of the superelevation may be run out on tangent. It is most important that full superelevation be attained at the point of full curvature, but we have found that 2 in. of superelevation may be run out on tangent without serious discomfort.

Are Still Higher Speeds Coming?

Will there be further increase in speed? Probably there will. It has been suggested that speeds up to 125 miles an hour are entirely feasible, with properly designed equipment. This may be true on tangent, but curvature, even as light as one degree, will sharply limit permissible speed.

We are not interested primarily in possible bursts of high speed. Shorter over-all time is the objective, so it becomes necessary to consider the factors that restrict speed. Most generally that is curvature. A 30-min. curve will allow almost any speed that is permissible on tangent and the superelevation will not be excessive. A 1-deg. curve with 7-in. superelevation will ride fairly comfortably at 125 miles an hour if in first class condition and properly spiraled, but what is the effect on a train running 60 miles an hour or slower? On curvature sharper than 1 deg., permissible speed is rapidly restricted, so if speed much higher than we have today is to be attained for long distances, an extensive program of curve reduction or elimination will be necessary. The expense of this will be prohibitive on many roads.

Some further shortening of schedules and increase of over-all speed is possible if power plants are used of such capacity, compared with the load, as to permit rapid acceleration in the higher speed brackets and to hold the maximum speed regardless of grade. Here again it becomes a question of cost. Increased power costs money.

On all roads there are physical conditions, occurring more or less frequently, that restrict speed. Owing to the fact that acceleration is slow in the higher speed brackets and that the attaining of maximum speed often requires more distance than is available between restrictions, a reduction in over-all time can be attained by the elimination of these restrictive conditions. By a careful study of the line and selection of those locations that are most restrictive or that most seriously increase over-all running time, and correcting those which can often be done at comparatively small expense, a material speeding up of the schedule may be possible at a cost that is not prohibitive.

We have only discussed passenger service and equipment and it is of this we generally think. We must, of course, also consider freight traffic. How much will it be speeded up and what must be done to make such increase possible? Here again I believe we must begin with the equipment if speed much faster than the present is desired. It is very common today for freight trains to be operated at 60 miles an hour and possibly faster. To speed up the over-all time of freight trains, the first effort should be to reduce terminal or yard delay. The extent to which this is possible will vary on different roads, but it is, I think, possible to some degree on nearly all. It is my opinion that we cannot expect running speeds much in excess of those now very general with present equipment and certainly not unless tonnage is further sacrificed.

No Basic Change In Track

With suitable motive power and equipment, no great change in the basic track structure should be necessary. On the trackman's part it becomes a question of greater attention to detail. On tangent I think that speeds of 125 miles an hour are possible. They will require almost perfect line and surface, excellent tie condition and great attention to rail joints and rail ends to almost eliminate rail end batter. None of these are impossible if money is available. Rail of improved quality with prehardened ends will be of value in attaining the required track standard.

At the risk of seeming to repeat, the need of close and constant attention to details must be emphasized. This is more necessary than it has been in the past. As speed increases, track condition, line, surface and gage must be made more nearly perfect and must be so maintained. This applies to both curve and tangent. This, of course, is no new idea, but the faster speeds we are now considering make it most important. Slight irregularities must be corrected promptly as they appear. The higher the speed the more noticeable these irregularities are and if not corrected at once, they rapidly become worse and additional track is forced out of line and surface.

Experience for a period of nearly three years has shown that once the track has been put in proper condition for high speed, maintenance costs are not increased greatly where suitable equipment is in use, if irregularities of line, surface and gage are corrected as they appear, but neglect for even a short time becomes serious.

Avoid Speed Restrictions

Experience has also taught us that if high over-all speed is to be attained, anything which restricts speed below the cruising average must be removed wherever possible. It is surprising how frequently physical characteristics such as curvature, turnouts at ends of double track, etc., which seriously restrict speed, occur on almost every line. Until recently a curve of two degrees was not thought of as serious. Where this was the maximum curvature, the alinement was considered very good, but when a speed of 90 miles an hour or over becomes necessary to make the schedule desired, a 2-deg. curve becomes restrictive.

Acceleration is slow in the higher speed brackets and each condition that causes a reduction below the cruising speed makes an on-time performance more difficult. Permanent speed restrictions due to physical characteristics require time to correct and the cost is often prohibitive, but a careful study of the line, checking it against a speed chart of train performance will often show that a comparatively small and inexpensive improvement such as curve reduction at strategic points will result in a decidedly improved performance.

Since every reduction in speed is so serious and since permanent restrictions are not easily removed, it is most important that there be no temporary restrictions such as slow orders, unless they are absolutely necessary for safety. To avoid slow orders may mean a change in working hours or a change in methods and practices in handling the work itself so that slow orders will not be in effect at a time when they will seriously affect the performance of the fast trains. If slow orders are necessary, the speed allowed should be as high as safety warrants and the order should be removed promptly when no

(Continued on page 489)

Power Augur

Cuts Tunnel for Jacking Culvert Pipe

The Cutting Bit, With the Spiral Conveyor Blades Behind It

ONE of the latest developments in the jacking process for installing pipe culverts under railway embankments is the method employed recently in the placing of eight reinforced concrete pipe culverts on the Western division of the Chicago, Rock Island & Pacific, between Stratton, Colo., and Limon.* These culverts, with pipe diameters ranging from 24 in. to 60 in., varied in length from 32 ft. to 84 ft., and three of them involved double lines of 60-in. and 48-in. pipe. The most unusual feature of the work on the Rock Island was the use of a power augur to remove the core of earth in advance of the pipe, instead of hand tunneling, by which means, all manual excavation was eliminated, except that required for seating the backstop and for laying the bed for the jacking frame and guide timbers.

Setting the Pipe and Jacking Frame to Grade With an Engineer's Level

The augur used in this work consists of a cutting bit with a set of spiral, tapered conveyor blades behind it, all mounted on the advance end of a horizontal power shaft. The bit, which is adjustable to the size of the pipe being placed, is a single steel blade, equipped with coarse cutting teeth. The conveyor blades act to carry the excavated material away from the bit. The entire augur assembly is supported in a frame which is bolted securely to the shell of the pilot pipe, and is driven through reduction gears by an electric motor.

Spoil Removed By Conveyor

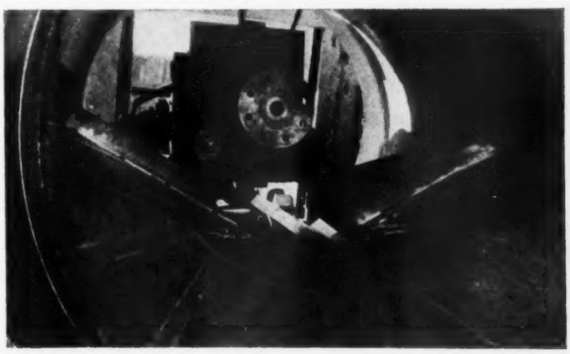
When in operation, the bit is forced forward into the soil by pressure on the rear end of the pipe, exerted continuously by two large-capacity hydraulic jacks that work against the jacking frame. Through the fixed connection between the pilot pipe and the augur, this pressure keeps the bit in constant contact with the earth wall, with the pipe face closely behind it. Ordinarily, the augur is so adjusted that it cuts from 2 to 3 in. ahead of the face of the pipe, but this distance can be reduced if found desirable because of the character of the material penetrated. Since the jacks have a run-out of more than six feet, they need to be reset only as each new six-foot section of pipe is placed in position, saving considerable time.

The spoil, instead of being removed by hand, is carried up an inclined semi-conical apron by the tapered conveyor blades, and then drops onto a motor-driven belt conveyor which carries it backward to the open end of the pipe. The conveyor, which is designed to permit lengthening by six-foot increments as each new section of pipe is added, is lengthened by merely inserting additional sections of belt.

The experience with the augur equipment on the Rock Island indicates that through its use the grade and alinement of the culvert being placed can be kept under accurate control at all times. After the first section of pipe is rolled into position on the jacking bed, it is correctly lined up with respect to grade by an engineer's level, and the rotary drill is then centered in its leading end.

Can Adjust Grade

As the jacking progresses and successive sections are set in position in the jacking bed, one at a time, their positions are likewise checked by level. If any deviation is found in the grade or line of the pipe as it is being installed, it can be corrected by adjusting the arms which support the cutting bit, thus altering the direction of the tunneling by the amount desired. While the pipe will generally follow the tunnel closely, even though altered slightly in its course, it can be aided in this regard as may become necessary by increasing the pressure on one or the other of the jacks, which are arranged



The Augur Removed to Show the Reduction Gear Housing and the Collecting Aprons of the Belt Conveyor

*For previous articles in *Railway Engineering and Maintenance* describing the jacking method see the issues of March, 1926, May, 1926, November, 1928, and May, 1931.

to be operated independently with this purpose in mind.

In installing culverts by this method, the cutting radius of the augur bit is usually set so that it bores a tunnel approximately 1½ in. smaller than the outside diameter of the pipe. No difficulty is occasioned in forcing the pipe into this undersized hole, while, at the same time, this arrangement insures a tight fit of the pipe in the soil, without the possibility of surrounding voids which, through water seepage, might cause settlement of the roadbed.

Removes Danger of Cave-Ins

Since the augur removes the earth only a few inches in advance of the forward end of the pipe, and since the cutting blade is constantly in contact with the face of the excavation, the danger of cave-ins is reduced to a minimum, even when penetrating loose-running soil. However, to guard against the possibility of cave-ins when in even the most treacherous soil, the augur shaft can be adjusted to permit the receding of the bit toward the face of the pipe, thereby still further reducing the unsupported length of excavation, and arrangement can be made for jacking the pipe forward as rapidly as conditions call for. Through these adjustments, the hazards of hand tunneling are avoided, as well as the possibility of serious cave-ins which might cause

(Continued on page 490)

Spoil Delivered Off the End of the Conveyor at the Mouth of the Opening

Maintenance Forces Involved in Two Accidents

THE Interstate Commerce Commission has issued reports during the last month on two accidents due to failures of roadway facilities that are of special interest to maintenance of way men by reason of the further precautions in maintenance practices that they suggest. The reports of the government investigations on these accidents follow.

Missouri Pacific

ON June 11, a passenger train, consisting of 14 cars and the locomotive, was derailed on the Missouri Pacific 2.6 miles north of Hematite, Mo., as a result of high water, resulting in the death of the engineman. Between Horine, Mo., 3.5 miles north and De Soto, 9 miles south of the accident, the line follows Joachim Creek, which it crosses six times. During the night of the accident it had been raining almost continuously, from 6 to 7.84 in. having fallen in the watershed of Joachim Creek between 6 p.m. on June 10 and 6 a.m. on June 11. Because of the heavy rain the crew of No. 7, the train involved, had received an order to proceed carefully at all points likely to be affected, and the train was traveling at a speed of between 15 and 20 miles an hour when it was derailed, at 3:03 a.m.

When the train crossed Bridge 24, the second bridge north of the point of derailment, it was noted by the fireman that while the stream was bank full and there was a swift current, the water had not reached the ties. Between this bridge and a point about 250 ft. north of the derailment, there was no water close to the track and no indication of bad track conditions. At Bridge 25 the water was practically up to the ties and very turbulent. Immediately after the locomotive passed Bridge 25, however, it encountered water over the rails and had moved only about 300 ft. through it when the track gave way and the locomotive turned over and was submerged. The first three cars, all express cars, were derailed and partly submerged; the remaining cars were not derailed, except the forward truck of the fourth car.

The section foreman at De Soto, in charge of the section adjoining the Hematite section on the south, patrolled his entire section beginning about 10 p.m., accompanied by his full gang, and found no bad track conditions, although at one point the ballast had been washed from between the ties. About 3:30 a.m. the dispatcher received a report from the foreman at Pevely, in charge of the section adjoining the Hematite section on the north, that he had been over his track and that everything was all right.

The section foreman at Hematite, the section on which the derailment occurred, stated that he retired at 8:15 p.m. and slept soundly until 4 a.m., when he arose and noted that Joachim Creek, which is near his home, had overflowed. He did not learn of the accident until he called the dispatcher at 6:30 a.m. to get his line-up. There was no telephone in his home and when the dispatcher wants him to patrol his track he must send someone from De Soto to notify him. He said that he has instructions to resume duty in an emergency and his men have authority to patrol the track without instructions from him if necessity arises, but they too had retired early and slept soundly and were not aware of any unusual weather conditions.

Could Not Reach Foreman

In its discussion of the evidence, the Bureau of Safety stated that "the rules and instructions for maintenance of way employees provide that during heavy storms or high water the foremen and trackmen must be on duty, whether by day or by night, and patrol their sections to make sure that the track is safe.

"The foremen on the adjoining sections were called by the dispatcher and no doubt the foreman at Hematite would also have been called if the dispatcher could have communicated with him. It is not unnatural for men to sleep soundly even during heavy storms, and the execution of important night emergency duties should not depend upon the chance that those who are to execute them will awaken at the proper moment. Some means of warning all section foremen should be available to the dispatcher at all times.

"The last train over this track was

No. 55, at 12:45 a.m., more than two hours before the derailment; at that time nothing unusual was noted, but dangerous conditions arose subsequently and it is probable that the accident could have been averted if the track had been properly patroled."

Fort Worth and Denver

ON THE morning of June 16 a locomotive plunged through a high trestle on the Ft. Worth & Denver City near Samnorwood, Tex., resulting in the death of two employees and the injury of another. This accident, which involved a northbound freight train on a branch line extending from Childress, Tex., to Pampa, occurred at a bridge over Salt fork, a tributary of the Red river.

The structure in question is a 920-ft. open deck creosoted pile trestle which was built in connection with the construction of the line in 1932. The bed of the river lies from 50 to 65 ft. below the track, and each bent consists of seven piles varying in length from 70 to 85 ft. The whole structure is strongly braced with sway, tower and longitudinal bracing. The cords consist of three 9 in. by 24 in. stringers under each rail.

On the afternoon preceding the accident, the foreman on the section upon which it occurred informed the dispatcher that his motor car was not in running order and if any condition arose which would require track patrol it would be necessary to rely on the foremen from the adjacent sections. To make sure that this matter was fully understood, he also notified the adjacent foremen, giving them the same information he had given the dispatcher. At this time, the sun was shining and there were no indications of the storm that was to break later. About 11 p.m. on the same night a cloudburst occurred in the upper end of the area draining into Salt fork, about 30 miles upstream from the bridge. As it progressed to the east, it also extended to the south with diminished force but still as a general heavy rain.

The Bureau of Safety investigated the accident, and in its report, of which the following is an abstract, it quoted a circular issued by the superintendent of the Amarillo division under date of March 16, 1938, in which particular attention was called to the maintenance of way and structure rules relative to the duties of section foremen in which it is required that they must go over their sections during or after a storm either by day or by night and watch carefully at all places where trouble is likely to occur. These rules also require that if on arrival at the end of their section it appears probable that the adjoining section may have been damaged and this condition not discovered by the foreman of that section, they will continue as far as is considered necessary to insure safety to trains or until the foreman of that section is met.

In the evidence which was taken at the investigation and which was included in the report, it was brought out that the superintendent of the Amarillo division got in touch with the section foreman at Abington, informing him of the heavy rains reported near Magic City about 30 miles north of Salt fork and instructed him to go north until he met No. 91, a south bound freight train, and to precede that train southward. The superintendent also met the conductor of train No. 92, the train involved in the accident, and informed him of the heavy rain and instructed him to advise the engineman to run safely. The foreman proceeded northward about 47 miles to a point approximately 11 miles north of Salt fork bridge where he met the foreman in charge of the second section north of his. He then returned to the Salt fork bridge at about 2 a.m., making an inspection of the structure. At this time there was only about 3 ft. of water in the stream and no driftwood. At Wellington, 10 miles south of Salt fork, he met the crew of No. 92 and informed them of weather conditions and the fact that the water was rising in Salt fork.

No. 91 passed over Salt fork between 2:30 a.m. and 2:50 a.m. At that time the water had risen to about 5 or 6 ft. deep and the current was swift. The crew stated that while there was some grass and vegetation against the piling, there was no evidence of other drift. This train met No. 92 at Wellington and handed the crew a message reading "Hard rains Meldavis to Bellco. Have someone go ahead of you. High water in Salt fork." As a consequence of these warnings, No. 92 slowed down to 5 miles an hour as it approached Salt fork, and had proceeded about a car length onto the bridge when five bents gave way, precipitating the locomotive into the stream which at that time had 14 ft. of water in it. No cars followed the locomotive and none was derailed except the first one, the forward truck of which fell into the opening. Inspection of the Salt fork bridge after the accident showed that bents 11 to 15, inclusive, were missing, in addition to which the tower bracing was broken out of the lower panel of two towers immediately south of the gap, and of five towers north of the gap. The report also states that the commission's inspectors found that the structure was in good condition prior to the night of the accident, but that in addition to the damage already described, the batter pile at the 20th bent on the south side was broken off at a point approximately 17 ft. above the creek bed. The maximum height of the water during the flood was apparently 14 ft. One bent was found about two miles down stream; all of the seven piles in this bent remained bolted together and were broken off about 50 ft. below the cap. Other pieces of piling which had been broken off at both ends were also found.

The commission's inspectors also found that approximately 400 ft. of a county bridge across Salt fork located about 7 miles upstream from the railway bridge was washed out during the night of the accident. This was an all-wooden bridge, parts of which were found downstream near the wreckage of the railway bridge.

In its discussion of the evidence, the commission stated that "apparently the wreckage of this highway bridge drifted down and struck bridge N-262.19 with such force that it broke the piling and shoved the bridge out of line, weakening it to such an extent that it collapsed under the engine of No. 92. There was no indication that scouring of the creek bed was in anyway responsible for failure of the bridge."

Meeting Today's Demands

(Continued from page 486)

longer necessary. Here it is that the track man and the supervisory maintenance officer can and must help by so planning the work as to avoid slow orders.

The demand today is for speed, safety, dependability, comfort and convenience and in most of these the railroads have more to offer than our competitors. The aggressive and progressive attitude of many railroads the last few years proves that there is still initiative and courage in management. Every employe has a part and must help if the railroads are to continue to maintain their place. We in the maintenance of way department have a part and a responsibility that is most important. Our service depends to a large extent on the key man, the foreman.

What to Do—When Rail Becomes Curve Worn?*

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ONE cannot say categorically that it is more economical to transpose rail on a curve when it becomes worn or to lay new rail, for the character and volume of traffic, speed, rate of curvature, roadbed conditions and weight of rail vary so widely that every[1] curve becomes an individual problem. I recall a case in heavy-traffic territory where it was necessary to lay new 100-lb. rail around sharp curves at intervals as short as 10 months, and, if traffic was unusually heavy, these intervals were still further shortened to 9 months.

Eventually, substantially unworn, full-length 130-lb. rail was taken from tangents on a well-maintained, high-speed district, where it had been in service for six years, and was used to replace the worn 100-lb. rail on these curves. Owing to the cold-rolled case-hardened finish of the 130-lb. rail, it was 19 months before this rail became worn enough for the gage side of the head of the high rail fully to correspond with the contour of the wheels. After that, the wear was rapid and the rail had to be transposed within eight months. In the meantime the track had not been gaged, so that when the transposition was made the gage was about 1 in. wide. The head of the low rail had been somewhat flattened and there was a small grove, probably from false flanges, along the outer side of the running surface.

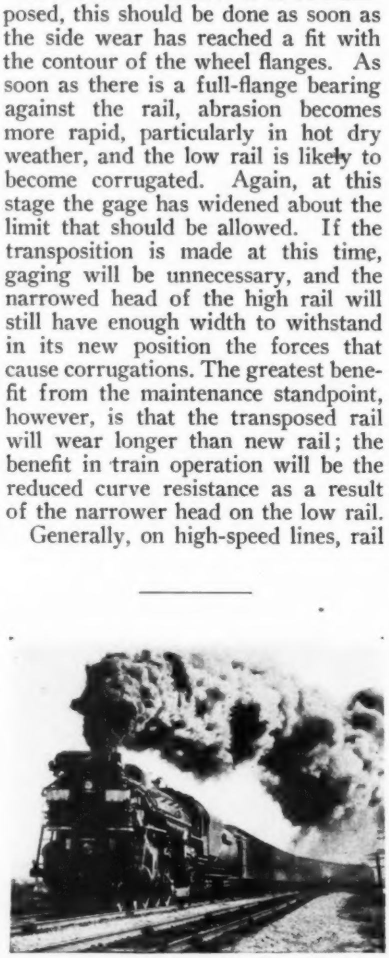
At the end of 27 months the high rail was shifted directly across to the inside of the curve, while the inner rail was turned end for end before it was laid on the high side. Because of the grooving, this rail was canted 1 to 20 to give full contact with the wheel treads immediately after it was transposed. In the transposed position, the 130-lb. rail lasted an additional 23 months under heavier traffic than had previously been handled over this district.

*This discussion was submitted for publication in What's the Answer department in the June issue as an answer to the question whether it is more economical to transpose curve-worn rail or to lay new rail. Because of its scope, it was withheld for presentation here as an independent article. For further discussion of this subject, see page 383 of the June issue.

In many cases it is economical to lay new rail on high speed lines. When it has worn to the point where some action is necessary, it can then be renewed with new rail and, if it has been properly maintained for the high speeds, it will be well-seasoned and suitable for replacing worn rail on curves on low-speed lines. If it is transposed when it is relaid, it will take more than twice as long for the flanges to wear through the case-hardened skin of the outer rail, as it will to wear an equal amount on rail that has been laid new. However, after the flanges of the wheels have worn the rail sufficiently to give them a full bearing against the side of the head, the rate of wear will correspond substantially to that of new rail after it has been worn to a like contour.

If the rail on a curve is to be transposed, this should be done as soon as the side wear has reached a fit with the contour of the wheel flanges. As soon as there is a full-flange bearing against the rail, abrasion becomes more rapid, particularly in hot dry weather, and the low rail is likely to become corrugated. Again, at this stage the gage has widened about the limit that should be allowed. If the transposition is made at this time, gaging will be unnecessary, and the narrowed head of the high rail will still have enough width to withstand in its new position the forces that cause corrugations. The greatest benefit from the maintenance standpoint, however, is that the transposed rail will wear longer than new rail; the benefit in train operation will be the reduced curve resistance as a result of the narrower head on the low rail.

Generally, on high-speed lines, rail should be changed often enough to avoid jittery riding conditions around the curve, and this will take care of wear on the rail without the question of transposition being brought into consideration. Economy will be conserved, for in this way good cold-rolled released rail will be made available for use on curves on low-speed lines. In this way, better riding conditions will be maintained on the high-speed lines, and longer life will be obtained from the rail when it is relaid on the low-speed lines.



Power Augur Cuts Tunnel

(Continued from page 488)

immediate or subsequent low spots in the roadbed.

The pipe used in the culvert installations on the Rock Island was unloaded from cars manually with the aid of a device called the "Crane Saver." This device consists essentially of a pair of sturdy steel skids which are placed against the side of the car as a ramp, which, in turn, support a cradle, capable of being moved up and down the ramp by compressed air taken from the train air line. The cradle is of sufficient size to handle pipe of any diameter, and lowers one section at a time, without jar or impact, thus eliminating the possibility of its becoming damaged or broken.

No Difficulties Encountered

With the exception of a delay caused by a dust storm that lasted approximately ten hours, no difficulty was experienced by the Rock Island in the placing of any of its culverts by the jacking procedure described. The soils encountered in the various installations are largely a sandy clay, and the average rate at which the pipe was advanced during actual jacking operations was approximately six feet an hour. Electric power for operating the augur, conveyor and hydraulic pump was supplied by a gasoline engine-driven generator mounted on a highway truck.

The culvert installations described were made under the direction of I. L. Simmons, bridge engineer of the Rock Island. Patents on the equipment used in this work are owned by American Railway Excavators, Inc., St. Louis, Mo., which is now offering the railways a culvert installation service, employing the methods described, on a contract basis.

How Often to Patrol Track

Is it necessary to patrol track daily in automatic signal territory? In non-signal territory? Why? If not, how often should it be patrolled?

Governed by Conditions

By R. L. Sims
District Maintenance Engineer, Chicago, Burlington & Quincy, Galesburg,, Ill.

In both automatic signal and non-signal territory, the frequency of inspection of the track should be governed by general track conditions, the importance of the line and the number of train movements. Daily patrol of the track is a practice on most roads, and has been required for many years, having been established when the track structure was by no means as good as it is today. On certain classes of lines, daily track patrol may now be more in the nature of a continuation of an established practice than the fulfillment of a real need for such inspection. On some branch lines, daily track patrol may be important; on others inspections on alternate days or twice a week may be sufficient. The frequency of track patrol to insure safe conditions for train operation, is, therefore, more or less of a local matter which must be worked out for each particular line.

Yes, Under Heavy Traffic

By A. E. Perlman
Engineer Maintenance of Way, Denver & Rio Grande Western, Denver, Colo.

In both signal and non-signal territory the necessity for daily track patrol will depend on the volume of traffic and the physical characteristics of the road. Ordinarily, the volume of traffic must be heavy to justify an installation of signals. Taking into consideration the hazards involved, that is, culvert or bridge failures, slides, washins and washouts, equipment that may have fallen from cars and lodged in switches or frogs, malicious tampering, grass and brush fires, none of which will affect the signal aspects, daily inspection is generally necessary on signaled lines.

When the possibility of rail failures, without warning in non-signal territory, is added to this list of hazards, it becomes readily apparent that, with the same traffic density, there is more need for daily inspection in non-signal territory than where automatic signals have been installed. On the other hand, there are many miles of lines of low speed and low traffic density, where the cost of daily inspection is not warranted.

Must Decide Locally

By Joseph H. Becker
Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

There should be little debate that a heavy-traffic main line, which it may be assumed has signals, should be patrolled daily. As external hazards increase, that is, slides, the possibility of washouts, fire hazards, unstable embankments, accumulations of snow and ice, etc., none of which are likely to be indicated by the signal aspects, the need for daily patrol increases correspondingly. On the other hand, on unimportant branch lines when the traffic is light and the speeds are slow, once a week may be enough. Between these two extremes there are many gradations, and the necessity

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in October

1. *What precautions should be taken to insure against the use of inferior gasoline, or dirt, or water in the gasoline, for use in gasoline-driven power units?*
2. *What practical methods can be employed to reduce breakage of window glass in enginehouses? What is the best arrangement for replacing them?*
3. *Who should make the annual tie inspection? Why? What check of the inspection should be made?*
4. *What is the most important cause of wear in wire rope? What can be done to reduce it? How often should wire rope be inspected and who should make the inspection?*
5. *What are the indications that rail is approaching the end of its service life? What changes occur in rail with age?*
6. *Under what conditions does it become necessary to pull the screen from a deep well? How can this be done?*
7. *Where track is to be given a general raise, is it desirable to set grade stakes on one side of the track or on both sides on tangents? On curves? Why? Should the grade line be referred to the top or to the base of the rail? Why?*
8. *When making a paint inspection, what details should be observed? What are the indications that determine whether painting is required?*

for track patrol and its frequency must be decided on the basis of the local requirements, with which division officers are most familiar.

Signal Protection Limited

By L. A. Rape
Section Foreman, Baltimore & Ohio, Claysville, Pa.

In considering this question it should be borne in mind that the protection afforded by the signals, so far as this refers to track conditions, is limited to clean breaks in rails outside the limits of the bond wires, open switches and, in cases of special provision therefore, slides and rock falls. Defective rails, rails only partly broken, or rails with several feet of the head broken out, will not affect the signal indication. Likewise, the signals offer no protection against loose guard-rail clamps; in fact, a guard rail can be removed from the track without changing the signal aspect. Again, a frog can be broken in such manner as to cause a derailment without affecting the signal. These are only a few of the hazards to train operation which can arise on the best maintained railway, against which the signals afford no protection.

For these reasons, I believe that track should be patrolled daily. It may be contended that some or all of these conditions may arise between the visits of the inspector on succeeding days. It is true that this might occur, but it is also true that many of the hazards do not arise suddenly, but require some time to develop and the chance of their occurrence is lessened by regular inspection. The need for daily patrol is increased or decreased in accordance with the density and speed of traffic and the quality of maintenance. To my mind, the fact that some roads have eliminated track walkers without an increase in accidents is not proof that they are not needed. To do away with daily track patrol is to gamble with safety, and the less frequent such inspections are, the greater the odds in favor of accident on any class of track.

Asbestos Shingles and Vibration

Can asbestos shingles or siding be used on a building that is subject to excessive vibration? If not, why? If so, how should they be fastened? In what ways can the vibration be reduced?

Must Use Care

By A. T. Hawk
Engineer of Buildings, Chicago, Rock Island & Pacific, Chicago, Ill.

To answer the question intelligently one must first determine what is considered excessive vibration. There is considerable vibration in all railway buildings near busy main tracks, such as passenger and freight stations, interlocking towers and similar structures, where trains pass at considerable speeds. Asbestos shingles and sidings are now commonly used on buildings of these types and I would say that the answer to the first part of the query is yes.

Particular care must be exercised to insure the proper fastening of this type of material which, supposedly, does not require any future painting and only inexpensive maintenance, and that very rarely. The nails must be of the non-rusting type, small in shank and head, but of sufficient strength to insure that the life of the nails will equal the life of the shingles or siding. There must be no rusting or corrosion of any kind in the nails or there will be a streaky, dirty appearance of the exposed surface of the material. Nails must be driven home with caution. If they are loose, the shingles will be likely to flap in the wind and the siding will move under the same force. If they are too tight they will invite the cracking of the corners where they have been applied. Anyone familiar with the application of slate or wood shingles will understand the technic that is essential for a good job with asbestos products.

Usually, the application of asbestos shingles and siding is, or at any rate it should be, made over a waterproof building or roofing felt. This will act both as an insulating medium and as a cushion to absorb any reasonable shock that might be transmitted through the framework of the building from outside vibration. This insulation will add greatly to the life of this type of roofing and siding.

Selection of asbestos shingles and siding requires careful consideration of both the materials used and the manufacturing details that are essential to insure long life, freedom from excessive weathering and discoloration of the exposed surface, and resistance to reasonable shocks without breaking.

Will Stand Vibration

By General Inspector of Buildings

So far as my experience goes, any one who is familiar with the application of slate roofing should be able to lay asbestos shingles or apply asbestos siding, for the technic of the operation is essentially the same for both types of material. I see no reason why asbestos shingles or siding should not be satisfactory under any vibration that is likely to be experienced in buildings alongside railway tracks. If the vibration is especially severe a layer of heavy felt similar to slater's felt can be used; in fact, it is desirable on all asbestos shingle jobs.

If the building is to house heavy machinery which is likely to cause severe vibration, this can be reduced materially by a layer of sheet lead over the foundations and piers and under the machines. In general, I prefer this to the cork cushion that is sometimes used.

Can Be Used

By Frank R. Judd
Engineer of Buildings, Illinois Central, Chicago

Our experience is that asbestos roofing and siding can be used with satisfactory results on railway structures that are subjected to vibration from moving trains. Asbestos shingles should be laid with the same care as slate shingles. The nails should be made of non-corroding metal; ordinary galvanized iron nails will not last the life of the shingle. The sheathing should be of sufficient thickness to prevent complete penetration by the nail.

If the sheathing is too thin and the nails project through it, vibration may cause the shingles to loosen and considerable later maintenance may be necessary as a result. The nails should be driven to a snug fit; that is, tight

enough so that the shingle cannot move, but not enough to place stress in the material. If the nails are driven too tight, the initial stress in the material may be increased by expansion, contraction or vibration, and cause the shingles to fail. It is essential, therefore, that asbestos shingles and siding be applied by experienced men, as the general tendency of those without the proper training is to drive the nails home and thus cause the shingles to cup so that the moisture may be driven under the exposed edge and the shingles eventually fail from frost action.

Asbestos materials to be used for roofing and siding should contain enough asbestos fibre to act as reinforcing to overcome the brittleness of the cement which comprises the binder. Most manufacturers turn out a satisfactory product, and it is essential that in making an application of these materials the manufacturer's instructions be followed carefully.

Accuracy in Driving Pile Bents

To what degree of accuracy can pile bents be driven? What methods can be employed to increase the accuracy of driving?

Can Be Done Several Ways

By H. Austill
Chief Engineer, Mobile & Ohio, St. Louis, Mo.

In 1914 and 1915, the Mobile & Ohio replaced a frame trestle 2,939 ft. long with a 6-pile trestle, no piles having been driven in this structure previously. The soil, containing sand, clay and gravel, was firm. There are three curves on this trestle, and the center line of each bent was located with a transit, while a peg was driven for the location of each pile. The piles line up as accurately as the posts in a framed trestle, and the bracing and deck timbers could have been preframed and every piece would have fit.

On the other hand, on the old main line many trestles were framed, using buried mud sills, into which three posts were mortised. These structures were replaced, first by 3 and 4-pile bents and later by 6-pile bents. Many of the old mud sills remain buried from 6 to 8 ft. below the surface and the old pile stumps are so thick that it is now difficult to drive piles without striking some of them. In these cases it is impossible to drive piles to exact location within reasonable cost.

In general, if no obstructions such as boulders, timbers, logs, etc., are encountered, and the pile has been located accurately, and if the strike of the hammer is in line with the axis of the pile, it can be driven to exact location. Piles to be driven into gravel, or with the aid of water jets, should be pointed accurately. However, the ends of piles that are to rest on rocks or that are to be driven into very soft soil should be blunt or squared. It is very important in these cases that the ends be cut exactly at right angles with the axes of the piles. It is often an advantage to dig a hole from 1 to 3 ft. deep at the exact location of the pile with a post-hole digger, to insure a correct start for the pile.

Except in very porous or swampy soil, the use of water jets is advantageous in controlling piles. By pointing a pile and using two jets, sinking one deeper than the other in the direction the pile is to be moved, it can be driven quite accurately. In clay it is sometimes best to sink a jet ahead of the pile, in the exact location it is to occupy. The use of a good form of metal shoe is an advantage where obstructions are likely to be encountered.

With Complete Accuracy

By L. G. Byrd
Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

Over a period of nine years during which we have been engaged constantly in redriving both ballast and open-deck trestles, some of them quite long, it has been my experience that piles can be driven with complete accuracy where one is willing to make the necessary preparation and exercise the necessary care in driving. This will consume more time than formerly when timbers were framed in the field, but in the long run this extra time is well spent and will give returns far in excess of its cost. In fact, it is actually essential if bridge timbers are to be preframed and expected to fit without cutting or boring on the job, a practice which no road can afford to ignore today.

My practice is to make a survey to determine the spacing and location of all bents from previous drivings, and prepare a sketch to scale showing this information. Most of these former bents do not conform in spacing to our present standard, and it is necessary to plot the bents of the new structure upon the drawing, shifting the whole number of spaces one way or the other to provide the least interference from the old bents. After the location of each bent has been established, the work is transferred to the field where, with a steel tape and a plumb bob the centers of the new bents and the location of every pile are determined, the latter at the elevation of the cutoff. From this point the spread of the pile is ascertained by the distance from the cut off to the ground and a stake is set for each pile. When the driving is started, holes two or more feet deep and of approximately the same diameter of the piles are bored as an initial guide in driving.

If the new bent falls at the same point as an existing bent, it is seldom necessary to pull more than two piles, generally the outside ones. In fact, unless the new trestle contains 20 or more spans, there is little likelihood that any of the new and existing bents will coincide, provided the proper care has been exercised in locating them upon the drawing. It is highly important that the driver be spotted accurately and that the leads be set correctly, as well as that the pile be placed in exact position before the hammer is allowed to rest upon it. If the pile has a bend, it should be placed so that the bend will fall in the plane of the bent. If it has a tendency to spring when released from the hammer, it will then spring toward the center line rather than away from it.

Particular care should be exercised in spotting the pile-driver leads and to see that the driver is not moved until the required penetration has been obtained. When the bents are to be driven in water more than 3 ft. deep, it may be necessary to attach temporary longitudinal braces to the ex-

isting bents and place a yoke resting on these braces, for the full length of the new bent. In erecting the yoke, spacer blocks are inserted and struts are extended to the adjacent bents to insure against movement of the yoke longitudinally with the track. The yoke material is usually second hand 8-in. by 10-in. or 8-in. by 16-in. timbers, and binders, held by bolts, are attached so that the yoke can be moved intact from bent to bent, to eliminate the labor cost of dismantling and reassembling. When setting the piles, one man can easily guide them through the opening in the yoke, and it is surprising to one who has never used this scheme how easily the piles can be held in line when driving over water, even when relatively deep.

Fading of Straight-Color Paints

What is the cause of fading of straight-color paints employed for trim and sash painting? How can it be prevented?

Unsuitable Pigments

By General Inspector of Buildings

In almost all cases this trouble can be traced to the selection of unsuitable pigments or application of the paint over the wrong type of undercoat. Dark-colored paints such as the greens, browns, blacks and reds commonly employed for trim and for painting sash contain no white. A dark-colored paint made from suitable pigments should give no trouble on the score of durability or permanence of the color. It should not be lost sight of, however, that some colors used for paints are not durable, but fade quickly when exposed directly to sunlight.

Chemically pure pigments are more durable and the colors more permanent than pigments that consist of an admixture. The metallic and earth pigments are more stable than those having an analine base. Extended colors, that is, pigments diluted with barium sulphate or aluminum silicate do not make good straight-color pigments because of the low refractive index of the adulterant salts, which makes them transparent when immersed in oil. This is a matter of no particular importance if the pigment is to be used for tinting, but if it is the sole pigment in the finish coat, as is the case with straight-color paints, it becomes of prime importance, since the relatively large content of transparent pigment seriously affects its hiding power.

Although the barium and aluminum salts that are used to produce extended colors are transparent when in oil, they become opaque as soon as the surface of the linseed oil which acts as the binder begins to disintegrate, as all paint films do in the course of time. This then is the basic cause why straight-color paints appear to fade. To overcome the trouble it is only necessary to avoid the use of extender pigments.

Effect Is Exaggerated

By E. C. Neville
Bridge and Building Master, Canadian National, Toronto, Ont.

While straight-color paints applied on sash and as trim do fade, the effect of the fading is doubtless more noticeable and stands out more prominently by reason of the fact that it is surrounded by lighter colors and sharp contrasting backgrounds. This tends to exaggerate the effect in many instances and to give the impression that the fading is more severe than is actually the case. This is a well known phenomenon, and the thought has often been expressed by painters that when the rays of the sun strike the glass of the window panes they radiate enough extra heat to affect the adjacent sash and frames, thus causing the colors to fade more quickly than those on areas not exposed to this influence. This theory does not explain, however, those cases of the fading of trim that does not surround windows.

To guard against the fading of straight-color paints, great care needs to be exercised in the selection, preparation and mixing of the colored pigments. All tinting materials should first be thoroughly mixed in oil before they are added to the white-lead base. This will insure thorough dispersion of the pigment through the lead and result in a uniform as well as a more permanent color. It is important that the surface upon which the paint is to be applied should be carefully prepared and primed, and that ample time should be given for each coat to dry hard before the succeeding coats are applied, to insure a solid color.

When to Remove Expansion Shims

When laying rail, should the expansion shims be left in for a definite period, or should they be removed before the joint bars are applied? Why? If the former, for how long?

Before Permitting Traffic

By C. O. Enlow
Roadmaster, Panhandle & Santa Fe, Slaton, Tex.

Expansion shims should be allowed to remain in place until the joint bars are applied and enough bolts have been tightened to hold the expansion after they have been removed. If the shims are removed before the bolts have been tightened, the expansion allowance may be disturbed by the setting in of new rails as the work of laying advances. This closing up of the expansion allowance will completely defeat the purpose for which the shims have been used. It is hardly necessary to say that the shims should be removed before trains are allowed to pass over the new rail; otherwise the rail ends are likely to be injured in such a way that rail batter will start immediately and progress at a relatively rapid rate.

Wait for Anti-Creepers

By E. L. Banion
Roadmaster, Atchison, Topeka & Santa Fe, Marceline, Mo.

It is good practice to leave the expansion shims in place until after the joint bars are applied and the bolts tight. As further insurance that proper expansion allowance will be maintained, the shims should not be removed until the anti-creepers have been installed. Obviously, both the application of the anti-creepers and the removal of the shims should be completed before any trains are allowed to move over the track.

To insure correct expansion allowance, it is necessary to consider the design of the shims. It is poor practice to use wood shims, broken keg staves or any other kind of shim that cannot be removed readily after the joint bars are applied. Metal shims should be of such design that rail cranes, compressors or other equipment employed in laying the rail, will not disturb the expansion opening when they pass over the shims. For several years we have used with entire satisfaction 1-in. sections of angle iron, the legs of which stand at 90 deg. The legs are unequal, one being ¾ in. and the other 1¼ in. long, and are beveled to permit wheeled equipment to pass over them. Each shim is stamped to indicate its thickness. To remove shims before the bolts are tight frequently results in unequal expansion openings.

Must Not Disturb

By Division Engineer

Metal shims are used to create the proper opening between abutting rails to allow room for expansion when the temperature of the rail increases. The thickness of the shim will, therefore, depend on the length of the rail and the temperature at which it is laid. It is essential that this opening shall not be disturbed by the operation of equipment employed by the rail gang, for which reason the shims should not be removed until the rail is secured in place by the application of joint bars, spiking and the placing of the anti-creepers. A rail gang should be so organized that full spiking and bolting follow immediately behind the setting in of the new rail, while the men applying the anti-creepers should follow closely behind these operations. As a consequence, by the time the rail crane is set in the clear and the track connected, it will be fully bolted and spiked, with the anti-creepers applied, and train operation can be restored immediately.

Remove Them Promptly

By Bernard F. McDermott
Roadmaster's Clerk, Chicago & North Western, Redfield, S.D.

It is important that expansion shims be removed promptly after the rails are fully bolted and spiked. The main purpose of leaving a number of shims in place for a short time is to insure against the closing of the expansion openings by the bumping of the rails that are being set into the track. As a rule, 20 shims will be enough to eliminate this possibility. If the temperature is rising, and the temperature of the rail increases, say from 60 to 101 deg., the whole string of 39-ft. rails in which the shims remain will be pushed ahead at the rate of ⅛ in. for each rail, instead of being taken up equally at each joint, as it should if the shims have been removed. Furthermore, every joint will have an opening at 101 deg., equal to the thickness of the shim, whereas it should be closed at that temperature. Under normal conditions, the rise in the temperature of the rail can be ignored, if no more than 20 shims are allowed to remain behind the rail crane.

Another matter that sometimes does not receive the consideration its importance warrants is the method of setting in the rail. If the far end of the rail is allowed to be too high as the near end is eased against the shim, and the far end is then lowered to its bearing, the expansion opening will almost invariably be greater than the thickness of the shim. Care should be exercised to insure a snug fit against the shim, and to do this the tongs should be applied so that the rail will be practically in balance.

Joints on Soft Roadbed

Should the joints be kept as tight on soft roadbed as on track that is well supported? Why?

Loose Joints Get Low

By L. A. Rape
Section Foreman, Baltimore & Ohio, Claysville, Pa.

It is the objective of every designer of rail and joint bars to make the joint as strong and stiff as the remainder of the rail, but unfortunately, this objective has not yet been fully attained. It can be more nearly realized with any design of joint however, if the bolts are kept tight. Yet, there is a limit to the tension that can be maintained in the bolts, since too much will not allow the rail to move in the bars in response to expansion and contraction, while it tends also to shorten the life of the bolts themselves.

A loose joint will get low sooner than a tight one, other things being equal, whether it be on a soft or a firm roadbed. For this reason, all joints should be maintained at the most desirable degree of tightness, regardless of the character of the roadbed. In other words, the rigidity or flexibility of the roadbed does not constitute a factor in the necessity for keeping the bolts tight if best joint conditions are to be obtained.

It is not altogether the fault of the design of the joint fastenings that joints get low, although some designs give more trouble than others in this respect. Nor is it the fault of the design that the joints tend to get low sooner than the rest of the rail. Again, it is not altogether the degree of tightness of the bolts that is responsible for this tendency, since the trouble inheres in the fact that as yet no joint has been designed which offers the same resistance to vertical loads that is possessed by the remainder of the rail.

Add to this the fact that the joint assembly is made up of a number of separate parts that are more or less free to move relative to each other as loads are applied on the running surface of the rail, and then removed in rapid succession, as trains pass over the track, and it will be seen that every condition surrounding the joint is favorable to its being pounded out of surface under the weight of traffic. This movement between the constituent parts can be reduced by tension in the bolts, and this is the thing that is desired whether the track is supported on soft or firm roadbed.

More Wave Motion

By F. B. La Fleur
Roadmaster, Southern Pacific, Lafayette, La.

There is every reason to keep track bolts as tight on soft roadbed as on firm roadbed. Every experienced trackman knows that joints are the weakest points in the rail and that there is more wave motion on track where the roadbed is soft than on firm solid roadbed. This motion tends to cause undue wear on the fishing surfaces between the joint bars and the rail. If the bolts are semi-tight and the roadbed is soft or yielding, the wave action at the joints under wheel stresses is more severe than on good hard roadbed. This results not only in wear on the fishing surfaces between the joint bars and the rail, but also in a tendency to bend the bars and to cause the rail ends to batter.

Under these conditions the joints will require more frequent raising and tamping, and this in turn will severely impair drainage at the point where it is most needed, as the continued tamping pulverizes the ballast. This brings on a cycle of more wear, more batter, more tamping and continued impairment of the drainage or frequent renewal of the ballast at the joint, leading to inevitable increase in maintenance costs, to the necessity for welding the rail and replacing the worn bars with new ones, with their incidental replacement of bolts and spring washers, as well as early failure of the joint ties through rail or plate cutting, or damage from excessive tamping. All of this work and expense can be reduced to the minimum by keeping the bolts tight.

Loose Joints Churn

By Joseph H. Becker
Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

In an experience with both extremes in the character of the roadbed, from rock to soft spots, I have found it to be the best policy to keep the bolts in the joints tight regardless of the support afforded by the roadbed. This experience has taught me also that it is of more importance in the maintenance of good track to keep them tight on soft yielding roadbed than on solid roadbed. In speaking of loose bolts I do not refer to joints in which the bolts have been allowed to get so loose that they have little or no tension in them, but to that condition in which they still have considerable tension, but are not under the maximum tension that can be applied and still permit satisfactory movement of the rail in expansion and contraction.

Loose joints show a decided tendency to churn and wear on the fishing surfaces, and this tendency is greatly increased as the bolt tension decreases. Churning joints not only get low quickly, but cannot be kept in surface. This trouble is more pronounced on soft roadbed than where the support is firmer. Joints that get low and churn always batter, and this not only increases the wear on the fishing surfaces, but magnifies the forces that cause the joint to get low and churn. No one can deny the advantages of tight bolts on the best of roadbed; no one who has had experience in the maintenance of track on soft roadbed is likely to contradict the statement that tight joints are of still greater importance where the roadbed is yielding, especially if the ballast is poor and tends to churn.

Selecting a Centrifugal Pump

What factors must be considered when the installation of a centrifugal pump is contemplated? What is the importance of each?

Many Factors Involved

By C. R. Knowles
Superintendent Water Service, Illinois Central, Chicago

Several factors are involved, each of which must be given careful consideration, in the selection of a centrifugal pump for a given service, including pumping and service requirements. It is an easy matter to secure a centrifugal pump that will do the required work, but at the same time it may not be the most desirable pump for the particular work it will be called on to do.

Unlike a reciprocating pump, a centrifugal pump must be designed for a fixed head to obtain the best results from it. In railway service, however, it is not always possible to avoid variations in the pumping head and, while centrifugal pumps will operate against variable heads within reasonable limits, wide variations should be avoided and the pump should be designed to pump against the mean between the average high and low heads.

Particular care should be exercised to avoid the operation of a centrifugal pump against heads so low that the rate of delivery will be greatly increased, because this will result in a waste of power and in overloading the pump. This factor is of particular importance where electric drive is employed, since the motor can be very easily damaged by overloading. To overcome this possibility centrifugal pumps to be driven by electric motors sometimes have an impeller of special design that will not permit the motor to be overloaded.

Suction and discharge heads are important factors in the selection of a centrifugal pump. The speed at which it is to be operated is another factor of importance. The cost of a single-stage pump is much less than of one of the multiple-stage type. A single-stage pump operating at 1,800 rpm. will deliver water against a head of approximately 200 ft., while to pump against heads up to 300 ft., it will be necessary to operate such a pump at about 4,500 rpm. The speed of the pump should be kept as low as is consistent with the service performed because there will be excessive wear at the higher speeds.

The type of power available is also important, since this will affect the method of drive. Centrifugal pumps must of necessity be operated at relatively high speeds. The electric motor is particularly adapted for driving centrifugal pumps, since a complete assembly of pump and motor offers one of the simplest pumping units made. This is also true of steam-turbine operated pumps which, of course, are chiefly in the larger sizes, although a few are adapted for ordinary roadside tank service.

Other types of drive usually require some form of speed transmission which will increase the speed to meet the needs of the pump, or a belt drive is sometimes used with driving pulleys of the required diameter. An excellent form of transmission from a power unit with a speed less than that required for the pump, such as an oil engine, is by means of V-type belts.

If the pump is to be operated automatically, provision should be made to keep the pump primed at all times, and if operated against a suction head, which is usually the case, a foot valve must always be provided and some sort of priming device which will operate automatically. While many pumps are equipped with iron impellers, if they are subject to corrosion, the impeller, the wearing rings and the bearing sleeves should be constructed of bronze or other non-corroding material.

Must Know All Facts

By Water Service Inspector

One cannot select a centrifugal pump on the basis of its capacity alone and expect it to give satisfactory service. He must know all of the items in the particular installation and select the pump having characteristics that most nearly fit the conditions under which it will be used. Thus a steam pump may be used to pump a large volume of water against a low head or only a slightly smaller volume against a much greater head with complete success. With the centrifu-

gal type, however, the volume of water pumped is in inverse ratio to the head against which the pumping is done.

It is imperative that the pumping head be given special attention for two reasons. While a centrifugal pump can operate against a wide range of heads, its greatest efficiency is at the particular head for which it is designed. Again, the amount of work done depends on the volume of water discharged rather than on the head against which the pumping is done. For this reason, if a pump that is designed for a relatively high head is assigned to a station having a low head, it is probable that the pump—and the power unit—will be overloaded.

One of the disadvantages of a centrifugal pump is that it does not operate well on a high suction lift and another is the necessity for priming. For these reasons, it is desirable that the pump be placed as close to the source of supply as possible and that the suction lift be reduced to the practicable minimum.

If electric power is available, an electric motor is a satisfactory power unit and, if practicable, should be direct-connected through a flexible coupling. Direct-connected internal-combustion engines are equally adapted for operating centrifugal pumps, but require more floor space. Belt drives can also be used with either of these power units, particularly where it is necessary to set the pump low to obtain a satisfactory suction lift at low water, while the power unit must be kept at a higher level to insure that it will not be flooded during extreme fluctuations in the water level.

Crossing Line and Surface

What methods should be employed to keep railway crossings in good line and surface?

Line Depends on Surface

By L. A. Rape
Section Foreman, Baltimore & Ohio, Claysville, Pa.

In large part line depends on surface and, conversely, surface depends so much on line that there is little chance of segregating them completely. Despite this, in general, line gives the most trouble at the greatest majority of crossings, and the largest factor in disturbing the line is rail creepage on the tracks approaching the crossing. For this reason, one of the most important things for the maintenance forces to do is to apply sufficient anti-creepers on all rails converging at the crossings to hold them in place and thus relieve the strain on the crossing from creepage, expansion and contraction.

Likewise, surface is intimately associated with drainage. Poor drainage has ruined many a crossing. It is important, therefore, that adequate drainage be provided, although this may be rather difficult in many instances. Yet its importance is so great that one can afford to go to any reasonable expense to provide it. Original provision is not enough, however, for it should be maintained at a high state of effectiveness at all times, that is, ditches and pipes should be kept cleaned and ready for effective use when needed.

On the other hand, surface depends in large measure on the smoothness of the running surface of the crossing itself, of the rail and on the amount of or lack of impact as the wheels move over the crossing. While severe impact may result from poor support for the ties, as in wet and churning ballast, or from loose bolts in a bolted crossing, the impact may be equally severe and quite as destructive if the running surface has been neglected and batter and wear on the frogs or corners of the crossing have been allowed to accumulate.

A few years ago, when a crossing had been allowed to get into this condition about the only remedy was to replace it with a new crossing. Today, however, through the development of welding it is seldom necessary to renew a crossing because of batter alone, for it is an extreme case if the surface cannot be built up and the crossing reclaimed, with its service life extended until renewal becomes necessary for reasons other than batter.

One of the ills that affects many crossings is inadequate base support. With the heavy locomotives and heavily loaded cars of today, and with the marked increase in speeds that has taken place during recent years, crossings stand in need of heavy base support. This can best be provided by thick wide plates, preferably welded to the crossing and to each other. Plates that are too thin quickly cup under the incessant pounding they receive, and no crossing can be maintained in good condition if it is supported on cupped plates.

Drainage First

By J. P. Datesman
Roadmaster, Chicago & North Western, Council Bluffs, Iowa

Drainage is the primary factor in keeping good line and surface at a railway crossing. Both observation and experience indicate that relatively few crossings are properly drained. This is not always the result of neglect on the part of the maintenance forces, however, but is often caused by conditions beyond their control, which prohibit provisions for adequate drainage. Railway crossings in terminals usually create the most difficult problems with respect to drainage, since the roadbed is generally flat and drainage outlets, such as storm sewers, are either non-existent or unduly expensive to obtain and to maintain. In such cases, some drainage can generally be provided by using porous material, stone, coarse gravel or even cinders, as ballast and by installing perforated metal pipe to carry off the excess water.

It is well known that crossings with one-way traffic exhibit a tendency to move with the traffic, but this can be overcome largely, if not entirely, by an adequate application of anti-creepers on the track approaching the crossing. Experience has also taught that the vertical movement in crossings, which particularly tends to wreck them, can be reduced by properly plating and tieing them, and that thereafter they can be maintained at minimum expense.

Ties should not be placed at right angles to either track but at right angles to the line that bisects the smaller angle of the crossing. This will insure a more even distribution of the loads, spreading them over the entire tie layout.

Further improvements can be made by the use of heavy steel plates to serve as a base or foundation for the crossing itself, keeping all parts level and in the same relation to each other at all times. Plates are especially beneficial for bolted crossings, since they reduce the wear on bolts and castings by holding movements under the traffic loads to the minimum. A plate 1 in. thick gives good results, although in many cases a greater thickness is desirable; in no case should the plate be less than 1 in. thick.

NEWS / of the Month !

Now Only a Freight Line

The Wheeling & Lake Erie has discontinued all passenger service. For some time only one train a day has been operated between Cleveland, Ohio, and Wheeling, W. Va., but after a steady decline in passenger traffic, permission to abandon the train was granted by the Interstate Commerce Commission.

I.C.C. Authorizes 2½-Cent Fare for Eastern Railroads

On July 5 the Interstate Commerce Commission authorized the Eastern railroads to increase their basic coach fares from 2 cents to 2½ cents per mile for a test period of 18 months. In this decision, which reversed a 6 to 5 decision of last April when a similar petition was denied, the commission expressed doubt that the 2½-cent fare would bring an increase in revenue to the Eastern roads, but admitted that the rate which will yield the greatest revenue "can be determined with reasonable assurance only through the 'trial and error' method."

Rutland Seeks Abandonment Federal Judge Orders Wage Cut

A petition to sell or abandon the entire 407 mile Rutland road has been filed with the U. S. District Court for Vermont by the receiver of the Rutland, L. G. Morphy, who has been ordered by Federal Judge H. B. Howe to pay the employees of the Rutland only 85 per cent of the present wages and salaries. Conferences at Rutland, Vt., concerning the 15 per cent wage cut which is scheduled to become effective August 4, were begun on July 11, and are being negotiated independent of the national wage reduction proceedings because it was felt that the decision in the national negotiations would come too late to be of any benefit to this road.

Competitors Meet 1½-Cent Rates of Santa Fe

To meet the reduction of fares from 2 cents to 1½ cents per mile inaugurated by the Atchison, Topeka & Santa Fe with the establishment of a co-ordinated rail-bus service between points in the San Francisco Bay district and San Diego, Cal., via the San Joaquin Valley and Los Angeles, the Southern Pacific and the Western Pacific railroads and the Pacific Greyhound bus lines have reduced their fares to 1½ cents in the San Joaquin Valley district in California. This rate is now in effect on the Southern Pacific from San Francisco, Cal., Martinez, and Stockton on the north to Redlands, Corona and San Bernardino on the south including intermediate points on the San Joaquin Valley line, and on the Western Pacific on its Stockton route. Permission to establish the co-ordinated rail-bus service and to reduce fares to 1½ cents which was bitterly contested, was granted the Santa Fe by the California Railroad Commission, and the service was established after the California Supreme Court on June 27 denied the petitions of the Southern Pacific railroad and Pacific Greyhound bus lines for a writ of review.

Tie Renewals in 1937

Data compiled by the American Railway Engineering Association's Committee on Ties from statistics covering the tie renewals of 136 class I roads of the United States, reveal that 78 railways in the United States renewed more ties per mile of maintained track in 1937 that in 1936, while 56 roads inserted less ties and two roads applied the same number in both years. Treated ties were applied exclusively on 36 roads (except in a few cases in which second hand ties salvaged from abandoned lines were also used); on 42 roads treated ties represented more than 80 per cent of all ties inserted; on 15 roads they represented from 80 to 60 per cent; on 6 roads from 60 to 40 per cent; on 14 roads under 40 per cent; while 14 railroads, all of limited mileage, used no treated cross ties.

Two Labor Groups Negotiate Wages Separately

Negotiations between the Carriers Joint Conference committee (representing the railroad managements) and the representatives of the labor organizations on the proposal to reduce wages 15 per cent, are being carried on independently with two separate groups of labor representatives. On July 18 at Chicago, negotiations were begun with representatives of the Brotherhood of Railway Trainmen headed by their president, A. F. Whitney, and on July 20 in the same city similar negotiations were undertaken with the Railway Labor Executives Association representing the other 20 brotherhoods. The trainmen have elected to act independently in the negotiations this year, although they were represented by the Railway Labor Executives Association in the wage controversy of 1937.

A. H. Peterson Becomes Editor of Maintenance Cyclopedia

Arthur H. Peterson has resigned as roadmaster of the Chicago Terminal division of the Chicago, Milwaukee, St. Paul and Pacific to become managing editor of the *Railway Engineering and Maintenance Cyclopedia*, a Simmons-Boardman publication. Mr. Peterson was born at Scranton, Iowa, on August 9, 1893, and worked during school vacations as a section laborer on the Milwaukee from 1905 to 1911. During 1911-1912 he taught school and from 1913 to 1917 he attended

Arthur H. Peterson

the University of Chicago. During the war he served as a first lieutenant of infantry, and after his discharge from the army he returned to the Milwaukee where he was employed in the maintenance of way department in various capacities. In 1919 he was promoted to section foreman at Spencer, Iowa, and in 1929 was again promoted to extra gang foreman on system rail laying and ballasting operations. In 1931 he was promoted to roadmaster of the Chicago Terminal division, which position he held until July 1, 1938 when he resigned to accept the position indicated above. Mr. Peterson has been active in the work of the Roadmasters and Maintenance of Way Association, of which organization he has served as chairman of various committees and of which he is now first vice-president.

Personal Mention

General

The jurisdiction of **W. W. James,** real estate, tax agent, and valuation engineer of the Central of New Jersey at Jersey City, N.J., has been extended to include the Reading Company, with headquarters at Philadelphia, Pa.

Warren W. Kelly, chief engineer of the Western lines of the Atchison, Topeka & Santa Fe at Amarillo, Tex., was promoted July 1, to general purchasing agent of the Santa Fe system, with headquarters

Warren W. Kelly

in Chicago. Mr. Kelly was born at Winfield, Kan., on November 30, 1885, and graduated from Rose Polytechnic Institute at Terre Haute, Ind., in 1907. He first entered railway service as a chainman on the Santa Fe during the summers of 1903 and 1906, and re-entered the engineering service of the Santa Fe in September, 1907, as a chainman. Mr. Kelly subsequently served as a rodman, transitman, assistant engineer, pilot engineer, chief pilot engineer, division engineer at Albuquerque, N.M., and at Los Angeles, Cal., and in February, 1924, he was advanced to district engineer of the Coast lines at Los Angeles. On September 1, 1929, Mr. Kelly was promoted to chief engineer of the Western lines, with headquarters at Amarillo, the position he held until his recent promotion.

Benjamin H. Hudson, superintendent of the Atlantic division of the Pennsylvania, and also of the Pennsylvania-Reading Seashore Lines, and formerly a division engineer on the Pennsylvania, has retired from active service. Mr. Hudson began his railroad career as a transitman on the Central of Georgia in November, 1890, and later became an assistant engineer on this road, subsequently resigning to become an engineer in charge of construction work on the Seaboard Air Line. In May, 1895, Mr. Hudson entered the service of the Pennsylvania as a track supervisor on the Grand Rapids & Indiana, being transferred to Petoskey, Mich., in 1899. In March, 1904, he was promoted to division engineer of the Southern division at Fort Wayne, Ind., and on August 1, 1905, he was advanced to superintendent of that division. Subsequently Mr. Hudson served as superintendent successively of the Fort Wayne, Logansport, Sunbury and Atlantic divisions and on July 15, 1933, he was appointed superintendent of the Pennsylvania-Reading Seashore Lines.

G. C. Jefferis, superintendent of the Oklahoma division, Eastern lines, of the Atchison, Topeka & Santa Fe, with headquarters at Arkansas City, Kan., and a maintenance officer by training, has been promoted to assistant general manager of the Northern district, Western lines, with headquarters at La Junta, Colo. Mr. Jefferis was born in Philadelphia, Pa., on September 27, 1889, and entered railway service on December 4, 1903, as a telegraph operator on the Pennsylvania. On March 28, 1911, he went with the Santa Fe as a chainman at Amarillo, Tex., and served successively at various locations in Texas and New Mexico, as a rodman, transitman, draftsman, assistant extra gang foreman, extra gang foreman and roadmaster. On June 16, 1917, he was promoted to division engineer, at Clovis, N. M., and he subsequently served as assistant superintendent of the middle division, superintendent of the Slaton division, and also of the Oklahoma division

G. C. Jefferis

with headquarters at Arkansas City, Kan. He was superintendent of the Oklahoma division at the time of his promotion.

Engineering

H. A. Wistrich, a bridge designer on the Lehigh Valley, at Bethlehem, Pa., has been appointed bridge engineer, with the same headquarters, succeeding **H. T. Rights,** who has been assigned to other duties.

P. O. Ferris, division engineer of the Delaware & Hudson, with headquarters at Oneonta, N. Y., has been appointed acting engineer maintenance of way, succeeding **H. S. Clarke,** deceased.

A. T. Danver, principal assistant engineer of the Rutland, with headquarters at Rutland, Vt., has been appointed chief engineer, succeeding **L. G. Morphy,** who has been appointed receiver of the road.

Guy H. Watson, assistant to the engineer maintenance of way, Boston & Maine, has been promoted to engineer of track, with headquarters at Boston, Mass., succeeding **George K. Thornton,** who has voluntarily retired from active duty after more than 51 years of service with the lines now comprising the Boston & Maine.

A. J. Flanagan, assistant supervisor of track on the Electric division, of the New York Central, with headquarters at New York, has been appointed assistant division engineer of the Eastern division, with the same headquarters, to replace J. P. Ensign, whose promotion to assistant engineer of track is noted elsewhere in these columns. **C. M. Gregg,** a transitman at Watertown, N. Y., has been promoted to assistant supervisor of track on the Electric division at New York to succeed Mr. Flanagan.

Eugene Y. Allen, who has been appointed assistant chief engineer of the Reading, with headquarters at Philadelphia, Pa., as reported in the July issue, was born at Camden, N. J., and was graduated from Princeton university in 1899. He entered railway service in 1901 with the Long Island. From 1902 to 1906, he served with the Pennsylvania on the construction of its tunnels under the Hudson river, and at the end of this period he served with the Hudson & Manhattan (affiliated with the Pennsylvania) also on the construction of tunnels under the Hudson river. In 1908, he became town engineer for South Orange, N. J., and during 1909-10 he acted as a selling agent for railroad and mill supplies. Next, Mr. Allen became office engineer for the New Jersey State Board of Assessors and served in connection with the revaluation of railroads and canals in that state. In 1914 he returned to railroad service as assistant valuation engineer of the Philadelphia & Reading (now the Reading) and of the Central of New Jersey. In 1921, Mr. Allen became valuation engineer of the Philadelphia & Reading and

Eugene Y. Allen

continued in this capacity when the railroad became known as the Reading. On April 5, 1934, he was appointed special engineer of this company, which position he held until his recent appointment.

S. R. Hursh, superintendent of the Maryland division of the Pennsylvania, with headquarters at Wilmington, Del., has been appointed acting engineer maintenance of way of the Eastern Pennsylvania general division, with headquarters at Harrisburg, Pa. Mr. Hursh succeeds **R. H. Crew,** who has been appointed division engineer of the Middle division at Altoona, Pa., to replace **W. R. Parvin,** who has been transferred to the office of the chief engineer at Philadelphia.

Charles W. Wilson, track supervisor on the Louisville & Nashville at Paris, Tenn., has been promoted to assistant engineer on the Louisville division, with headquarters at Louisville, Ky. Mr. Wilson was born at Paris, Tenn., on May 6, 1901, and entered railway service on September 27, 1920, as a rodman on the Memphis division of the L. & N. He was promoted to instrumentman on June 2, 1927, and on July 1, 1937, he was appointed track supervisor, the position he held at the time of his recent promotion.

Edward T. Barrett, whose promotion to engineer of track on the Denver & Rio Grande Western, with headquarters at Denver, Colo., was announced in the June issue, was born at Minneapolis, Minn., on April 20, 1905, and graduated from Marquette University in June, 1926. He entered railroad service on June 24, 1926, as a draftsman for the signal department in the general office of the Northern Pacific at Minneapolis, and later he was transferred to the engineering department in which he served as a draftsman, instrumentman and building inspector on location and construction of the Redwater branch in Montana. In April, 1929, he was transferred to location work on the Olympic Peninsula in Washington, and in the following year he was made a track apprentice. He was later appointed assistant bridge and building supervisor on the Yellowstone division, with headquarters at Glendive, Mont., and in November, 1934, he was promoted to roadmaster on the Fargo division, with headquarters at Fargo, N.D., later being transferred to the Yellowstone division. In July, 1936, Mr. Barrett left the Northern Pacific to accept the position on the D. & R.G.W. of division engineer, with headquarters at Alamosa, Colo., the position he held at the time of his recent promotion.

Edward T. Barrett

Clark Dillenbeck, chief engineer of the Reading with headquarters at Philadelphia, Pa., whose retirement on July 1 was reported in the July issue, was born on June 24, 1866, at Palatine, N. Y., and obtained his civil engineering education at Cornell university, graduating in 1888. He entered railway service in May, 1890, as assistant to the engineer of bridges of the Philadelphia & Reading (now the Reading). Four years later he was appointed assistant engineer and a short time later he was advanced to engineer of bridges and buildings. Mr. Dillenbeck became assistant chief engineer of the Reading and of the Central of New Jersey in 1918 during federal control of the railroads. Following the war he continued as assistant chief engineer of the Reading, being advanced to chief engineer in 1927.

Clark Dillenbeck

F. G. Smith, assistant engineer of track of the New York Central Lines, Buffalo & East, has been promoted to division engineer of the Pennsylvania division, with headquarters at Jersey Shore, Pa., succeeding **Howard B. Lincoln,** who has been transferred to Cleveland, Ohio, to replace **Phillip E. Manchester,** who has retired. **John P. Ensign,** assistant division engineer of the Eastern division, with headquarters at New York, has been promoted to assistant engineer of track with the same headquarters, to succeed Mr. Smith.

Mr. Ensign was born on June 7, 1898, in New York state and obtained his higher education at Union college. He entered railway service with the New York Central on May 15, 1923, as a draftsman being appointed track inspector on the Electric division on September 1, 1925. A year later he was further promoted to assistant supervisor of track on the same division, being advanced to assistant division engineer of the Eastern division, at New York, on September 1, 1933.

G. B. Stearns, whose promotion to valuation engineer of the Coast lines of the Atchison, Topeka & Santa Fe, with headquarters at Los Angeles, Cal., was announced in the July issue, was born at Huntsville, Tex., on September 20, 1886, and attended the University of California for one year. He first entered railroad service on August 15, 1912, as an estimator in the valuation department, after having had previous service in surveying work, from 1908 to 1910 and with J. G. White & Company on appraisal work from 1910 to 1912. He left the service of the Santa Fe in 1914 to work for the City of Chicago, but returned in 1916 as an estimator on revaluation work in the valuation department at Los Angeles. Mr. Stearns was appointed chief clerk in that office in August, 1918, and in March, 1927, he was promoted to assistant valuation engineer, the position he held prior to his recent promotion.

G. B. Stearns

Albert M. Zabriskie, who has been appointed assistant chief engineer of the Central Railroad of New Jersey with headquarters at Jersey City, N. J., as reported in the July issue, was born in New Hampshire in 1882 and first entered railway service in 1902 with the Lehigh Valley, serving in the engineering department of this company for about two years. In 1904, he entered the service of the Central of New Jersey as a transitman, later being appointed assistant engineer. In January, 1917, he was promoted to engineer of design and in October of the same year he was advanced to principal assistant engineer, which position he was holding at the time of his

A. M. Zabriskie

recent appointment as assistant chief engineer.

F. E. Bates, bridge engineer of the Missouri Pacific, with headquarters at St. Louis, Mo., has been promoted to chief engineer, a position which has been vacant since the death of **E. A. Hadley**

F. E. Bates

on November 11, 1932. **A. A. Miller,** engineer maintenance of way and structures, has been appointed chief engineer of maintenance of way and structures, a newly-created position, and the position of engineer of maintenance of way and structures has been abolished.

Mr. Bates was born at Allison, Iowa, on January 3, 1889, and graduated from the University of Wisconsin in 1908. Following graduation he entered railroad service in the engineering department of the Chicago, Milwaukee, St. Paul & Pacific, but left the next year to go with the Kansas City Terminal as a draftsman. Eight months later he re-entered the service of the Milwaukee. Mr. Bates entered the service of the Missouri Pacific

A. A. Miller

on November 13, 1913, as an assistant engineer, and in 1919 he was promoted to assistant bridge engineer. On August 1, 1923, he was advanced to bridge engineer, the position he held at the time of his recent promotion.

Mr. Miller was born at Zanesville, Ohio, on September 28, 1879, and graduated from Ohio State University in 1902. He entered railway service in June, 1902, as a rodman on the Baltimore & Ohio, with headquarters at Wheeling, W. Va., and served that road subsequently as a transitman, assistant engineer, and division engineer at Philadelphia, Pa. From September, 1907, to June, 1909, he was engaged as chief engineer for the West Coast Company at Los Angeles, Cal., and in June, 1909, he entered the service of the Missouri Pacific as an assistant engineer. In June, 1911, he was promoted to division engineer, and in January, 1918, he was promoted to district engineer. Mr. Miller was promoted to division superintendent in May, 1921, and in April, 1925, he was advanced to engineer maintenance of way and structures, with headquarters at St. Louis, the position he held at the time of his recent promotion.

T. A. Blair, district engineer of the Northern district of the Western lines of the Atchison, Topeka & Santa Fe with headquarters at La Junta, Colo., has been promoted to chief engineer of the Western lines, with headquarters at Amarillo, Tex., to succeed **Warren W. Kelly,** whose promotion to general purchasing agent of

T. A. Blair

the Santa Fe system is announced elsewhere in these columns. **Leon V. Lienhard,** division engineer at Arkansas City, Kan., has been advanced to district engineer with headquarters at La Junta, replacing Mr. Blair. **Kelley W. Claybaugh,** office engineer in the division engineer's office at Chillicothe, Ill., has been promoted to division engineer at Arkansas City, relieving Mr. Lienhard.

Mr. Blair was born at De Beque, Colo., on June 1, 1892, and graduated from the University of Colorado. He entered railway service in 1915 as a rodman on the Santa Fe at Pueblo, Colo., and in 1916 he was promoted to office engineer, with headquarters at Shattuck, Okla. During the war he served with the U.S. Army, but returned to the Santa Fe in 1920 as a building inspector on the Plains division. He was later appointed roadmaster, with headquarters at Pueblo, Colo., and in 1926 he was promoted to assistant engineer of the Plains division. Mr. Blair was advanced to division engineer of the Slaton division of the Panhandle and Santa Fe in 1927, with headquarters at Slaton, Tex., and in 1929 he was transferred to the construction department, working on the Orient extension, subsequently being appointed division engineer at Pueblo. In the summer of 1936, he was promoted to trainmaster, serving in that capacity at Slaton, and later at Wellington, Kan., and on August 1, 1937, he was advanced to district engineer at La Junta, the position he held at the time of his recent promotion.

Leon V. Lienhard

Mr. Lienhard was born at Cuero, Tex., on September 26, 1891, and graduated from Texas A. & M. College. He entered railway service in 1913 as a draftsman for the Santa Fe at Amarillo, Tex. He subsequently served in various capacities in the engineering department, and in September, 1926, he was appointed acting roadmaster of the First and Canon City districts of the Colorado division, with headquarters at Pueblo, Colo., later being promoted to roadmaster. In 1929 he was promoted to division engineer, with headquarters at Slaton, Tex., and in 1931 he was appointed roadmaster, with headquarters at Pueblo. In July, 1937, he was promoted to acting division engineer at Dodge City, Kan., and later was promoted

Kelley W. Claybaugh

to division engineer at Arkansas City, Kan., the position he held at the time of his recent promotion.

Mr. Claybaugh was born at Spickards, Mo., on July 12, 1900, and graduated from Kansas University in 1924. He entered railway service on November 5, 1917, as a telegraph apprentice on the Atchison, Topeka & Santa Fe at Pretty Prairie,

Kan., but left the Santa Fe to join the U.S. Army on August 6, 1918. He returned to the Santa Fe as a helper at Medford, Okla., on July 23, 1920, and worked the following three summers, between school terms, as a helper, agent, and as a chainman at Topeka, Kan. On May 21, 1924 he was promoted to rodman and later that year to instrument man. On November 4, 1925, he was transferred to Topeka as a draftsman, and on January 16, 1928, he was appointed transitman at Oklahoma City, Okla., on grade separation work. Mr. Claybaugh was promoted to assistant engineer at Oklahoma City on April 19, 1928, and was transferred to Topeka on March 1, 1930. He subsequently served as a transitman and a rodman at Newton, a draftsman at Topeka, and office engineer at Chillicothe, Ill., the position he held at the time of his recent promotion.

E. Carrion, division engineer of the National Railway of Mexico at Acambaro, Gto., Mex., has been transferred to the Queretaro division, with headquarters at Buenavista Station, Mexico, D. F., and **R. Dias Velez,** division engineer of the Gulf division, with headquarters at Monterrey, N. L., Mex., has been transferred to the Pacific division, succeeding Mr. Carrion. **J. G. Jauregui,** division engineer at Mexico, D. F., has been transferred to the Gulf division replacing Mr. Velez at Monterrey, and **Vicente Espinosa Palomino** has been appointed division engineer of theh Eastern division, with headquarters at Tierra Blanca, Vera Cruz.

Guy H. Watson, assistant to the engineer maintenance of way of the Boston & Maine, with headquarters at Boston, Mass., has been promoted to engineer of track with the same headquarters, to succeed **George K. Thornton,** who retired from active service on July 1, after 51 years of service with the lines now comprising the Boston & Maine.

Mr. Watson was born on February 23, 1880, at Lyndonville, Vt. and is a graduate of Norwich university. He entered the service of the B. & M. in December, 1902, as a rodman. Later he served with the Pennsylvania and the Central Vermont as assistant engineer of construction and resident engineer, respectively. He returned to the B. & M. in May, 1906, as assistant engineer and, in July, 1915, he was appointed division engineer of the White Mountains division. In 1925 he was transferred to the Portland division at Salem, Mass., and in April, 1927, he was promoted to assistant to the engineer maintenance of way, which position he held until his recent appointment as engineer of track.

Track

Roy A. Williams, track supervisor on the Wymore division of the Chicago, Burlington & Quincy, has been promoted to roadmaster, with headquarters at Wymore, Neb., succeeding **J. L. Baker,** who has been transferred to Lincoln, Neb., replacing **Bruce Campbell,** who has retired on account of ill health.

William H. Naas, whose promotion to supervisor on the Chicago Terminal division of the Illinois Central, with headquarters at Chicago, was noted in the June issue, was born at Cabery, Ill., on February 28, 1893, and entered railway service on November 16, 1914, as a supervisor's clerk on the Illinois Central. In October, 1926, he was promoted to assistant foreman, and in May, 1928, he was advanced to section foreman, the position he held at the time of his recent promotion.

E. E. Whitman, whose promotion to roadmaster on the Chicago, Milwaukee, St. Paul & Pacific at La Crosse, Wis., was announced in the June issue, was born at Lemonweir, Wis., on November 13, 1884, and entered railway service on June 1, 1902, as an extra gang laborer on the Milwaukee. On March 9, 1912, he was promoted to section foreman, and on April 1, 1929, he was advanced to extra gang foreman. He was promoted to general foreman of extra gangs on May 1, 1931, and held that position at the time of his recent promotion to roadmaster, with headquarters at La Crosse.

Edred Rushby, acting roadmaster on the Prince Albert division of the Canadian National, has been promoted to roadmaster at North Battlefield, Sask., succeeding **Robert Johnson,** who has retired. Mr. Rushby began railway service on May 1, 1907, as a section laborer at North Battlefield, and in 1908, he was promoted to assistant foreman. He was promoted to relief roadmaster in 1923, and in 1935, he was advanced to acting roadmaster on the Prince Albert division, the position he held at the time of his recent promotion.

Charles W. Cross, section foreman in the terminal of the Chicago, Milwaukee, St. Paul & Pacific at Council Bluffs, Iowa, has been promoted to roadmaster at Chicago, succeeding **Arthur H. Peterson,** who has resigned to become managing editor of the Railway Engineering and Maintenance Cyclopedia, a publication of the Simmons-Boardman Publishing Corporation, as noted in the general news columns of this issue.

Mr. Cross was born at Dedham, Iowa, on March 9, 1902, and entered railway service on June 1, 1913, serving in the maintenance of way department during vacations and holidays from school until the summer of 1920, when he became a regular employee. He was promoted to section foreman at Dedham, Iowa, on June 1, 1922, and on December 24, 1927, he transferred to Manilla, Iowa. On December 1, 1928, he transferred to Council Bluffs, where he served as section foreman of the terminal, the position he held at the time of his recent promotion.

T. C. Harvey, track supervisor on the St. Louis terminal of the Missouri Pacific, has been promoted to roadmaster on the Missouri division, with headquarters at Poplar Bluff, Mo., succeeding **J. Sisk,** who retired on June 1. **J. W. Jones,** extra gang foreman on the Memphis division, has been promoted to track supervisor on the St. Louis terminal, replacing Mr. Harvey.

Mr. Harvey was born at Warsaw, Mo., on August 9, 1892, and entered railway service on March 6, 1913, as a section laborer at Warsaw. He was promoted to section foreman at Sedalia, Mo., on September 28, 1914, and served in that capacity also at Knobnoster, Mo., Independence and Kingsville. On September 18, 1927, he was promoted to extra gang foreman, and on June 3, 1935, he was advanced to assistant roadmaster at Jefferson City, Mo. Mr. Harvey was appointed track supervisor on the St. Louis terminals on January 1, 1936, and held that position until his recent promotion.

Fred L. Stiner, section foreman on the Illinois Central at Aurelia, Iowa, has been promoted to track supervisor, with headquarters at Cherokee, Iowa, succeeding **F. T. Kraft,** who has been transferred to Dubuque, Iowa, replacing **J. W. Sims,** who retired on July 1. Mr. Stiner was born at Cherokee, Iowa, on August 28, 1903, and attended Oregon State College in 1923 and 1924. He first entered railway service on August 1, 1917, as a section laborer on the Illinois Central at Cherokee. On April 1, 1926, he was promoted to assistant foreman and machine operator, and on February 27, 1928, he was advanced to section foreman at Le Mars, Iowa. He later served as a relief foreman and again as a section foreman at Calumet, Iowa, Meriden and Aurelia. He was stationed at the latter point at the time of his promotion to track supervisor.

John O'Brien, construction gang foreman on the Atchison, Topeka & Santa Fe at Chicago, has been promoted to roadmaster at Chillicothe, Ill., succeeding **R. J. Yost,** who has been promoted to trainmaster of the Illinois division, with the same headquarters. Mr. O'Brien was born at Williamsfield, Ill., on March 19, 1894, and entered railway service in June, 1919, as a section laborer at Williamsfield. He later served as relief foreman at Williamsfield, as assistant yard foreman at Galesburg, Ill., and a relief foreman at various points until 1923, when he became a regular foreman at Dallas City, Ill. In 1924 he was advanced to extra gang foreman and in 1925, he was transferred to East Ft. Madison, Ill., on the Mississippi River bridge construction. In 1928, Mr. O'Brien was promoted to assistant roadmaster and in the summers of 1937 and 1938, he was a foreman on reconstruction work at the Eighteenth Street yards in Chicago, where he was working at the time of his recent promotion.

Ora D. Hoge, whose promotion to roadmaster on the Coast lines of the Atchison, Topeka & Santa Fe, with headquarters at Parker, Ariz., was announced in the July issue, was born on July 21, 1906, at Gridley, Kansas, and entered railway service on May 24, 1926, as an extra gang timekeeper on the Santa Fe at Newton, Kansas. He later served as a stenographer at Newton, roadmaster's clerk at Abilene, Kans., and car distributor at Newton. He left the railway in July, 1928, but returned on March 18, 1929, as a roadmaster's clerk at Winslow, Arizona, and on August 29, 1929, he was appointed payroll and distribution clerk at that point. He later served as a roadmaster's clerk at Gallup, N.M., and as a stenographer at

Winslow, Ariz., and section laborer at Gallup, N.M. On October 25, 1932, he was promoted to section foreman and on July 5, 1935, he was promoted to extra gang foreman. On January 10, 1938, he was appointed personal injury clerk and interpreter at Los Angeles, Cal., the position he held at the time of his recent promotion.

Bridge and Building

Murray Lennox, bridge and building foreman on the Canadian National, has been appointed acting bridge and building master of the Halifax division, with headquarters at Halifax, N. S., to succeed **Herbert A. McElhinney,** who has retired.

A. Z. Isaacks, water service foreman on the Gulf, Colorado & Santa Fe, has been promoted to general foreman, bridges and buildings, of the Gulf division, with headquarters at Galveston, Tex., succeeding **M. M. Killen,** who has been advanced to trainmaster on the Beaumont division.

N. M. Brown, supervisor of bridges and buildings on the Atlanta division of the Nashville, Chattanooga & St. Louis, with headquarters at Cartersville, Ga., has retired, effective July 1.

James E. Rawlinson, whose retirement as supervisor of bridges and buildings on the Louisville & Nashville, with headquarters at Louisville, Ky., was announced in the July issue, first entered railway service on August 18, 1887, as a laborer in a bridge gang on the Birmingham division of the L. & N., and later served as a carpenter and a bridge foreman. In 1895, he was promoted to acting supervisor of bridges and buildings on the Atlanta division, and in 1905 he was promoted to system bridge erector. He was appointed supervisor of bridges and buildings of the Louisville division, with headquarters at Louisville in 1914, which position he held until his retirement.

Alfred C. Tanner, who has been appointed supervisor of bridges and buildings on the New York Central with headquarters at Weehawken, N. J., as announced in the June issue, was born on October 10, 1891, and entered the service of the New York Central on May 10, 1909, as a carpenter on the St. Lawrence division at Watertown, N. Y. On February 1, 1919, he became foreman of a pile driver outfit and on August 1, 1925, he was promoted to assistant supervisor of bridges and buildings on the St. Lawrence division. On September 1, 1929, he was transferred to the Mohawk division and on October 20, 1931 he was appointed bridge inspector. Two years later Mr. Tanner was reappointed assistant supervisor of bridges and buildings, at Watertown.

L. S. Marriott, instrumentman on the Louisiana division of the Illinois Central, has been promoted to bridge and building supervisor, with headquarters at McComb, Miss., to succeed **W. L. Ratliff,** who retired on July 1. Mr. Marriott was born at Elizabethtown, Ky., on August 17, 1894, and attended Kentucky State University. His first railway service was during the summer of 1913 with the Louisville & Nashville. On June 7, 1915, he entered the service of the Illinois Central as a chainman on the St. Louis division. He was promoted to rodman on January 24, 1916, and on February 5, 1917, he was advanced to instrumentman on construction. During the war he served with the Engineers Corps and upon his return on July 16, 1919, he was again appointed instrumentman on construction. He subsequently served as a draftsman in the building department, and on February 1, 1923, he was promoted to assistant construction engineer in the building department. Mr. Marriott was appointed instrumentman on the Louisiana division on July 16, 1931.

John P. Wood, supervisor of bridges and buildings on the Detroit-Grand Rapids division of the Pere Marquette, with headquarters at Grand Ledge, Mich., who was granted a leave of absence on January 1, as reported in the February issue, has now retired. Mr. Wood was born at Atlas, Mich., on November 26, 1867, and entered railway service on March 1, 1888, as an extra gang laborer on the Saginaw, Tuscola & Huron (now part of the Pere Marquette). He subsequently worked as a section or extra gang laborer in the summers and taught school in the winters until 1899, when he was made a carpenter in a bridge and building gang. On July 1, 1905, he was promoted to carpenter foreman, and on September 1, 1912, he was promoted to supervisor. In adidtion to Mr. Wood's duties as supervisor of bridges and buildings he was also assigned supervision over water service on his territory from February, 1917, to February, 1920, and again from March, 1931, until the date of his retirement. Mr. Wood has long been active in the American Railway Bridge and Building Association, of which organization he was president in 1924-25.

Special

Lynn J. Turner has been promoted to the newly-created position of supervisor of work equipment of the Chicago, Rock

Lynn J. Turner

Island & Pacific, with jurisdiction over all roadway equipment and machinery of the maintenance of way department, in addition to his former duties as system rail inspector. He was born at Lapeer, Mich., on February 14, 1886, and attended Michigan State College in 1904 and 1905. He entered railway service on November 17, 1908, on signal construction work on the Rock Island at Walcott, Iowa, and later served as a signal maintainer at Letts, Iowa, Fairfield, and Muscatine. On May 9, 1918, he was promoted to division superintendent of motor cars, at Bureau, Ill., and on June 1, 1920, he was transferred to Des Moines, Iowa, as motor car inspector of the Iowa division. Mr. Turner was promoted to district motor car inspector, at Des Moines, on January 1, 1923, and on February 15, 1929, he was promoted to system rail inspector.

Obituary

Herbert S. Clarke, engineer maintenance of way of the Delaware & Hudson, with headquarters at Albany, N.Y., whose death on June 25 at Boston, Mass., fol-

Herbert S. Clarke

lowing an operation, was reported in the July issue, was born at Portsmouth, Ontario, on September 22, 1887, and was educated at the University of Toronto. During 1905, Mr. Clarke served as transitman on the Canadian Government well and canal survey; in 1906-1907 he was on the engineering staff of the city of Toronto and from 1908 to 1910, he was concerned with land and mine surveying at Cobalt, Ont. From 1913 to 1919 Mr. Clarke was location and division engineer for the Canadian Northern and from 1919 to 1921, was division engineer of the Delaware & Hudson at Carbondale, Pa. He was promoted to engineer maintenance of way of the Delaware & Hudson in 1921, with headquarters at Albany.

G. P. MacLaren, general tie and timber agent of the Canadian National, with headquarters at Montreal, Que., died on June 26 at the Royal Victoria hospital, after several months illness. Mr. MacLaren was born at London, Ont., on April 4, 1878, where he received his education at the Collegiate Institute and Huron College. He served apprenticeship in civil engineering with various railways at St. Thomas, Ont., Sault Ste. Marie and Bridgewater, N.S., and in 1906, joined a predecessor company of the Canadian National as division engineer at Quebec.

Three years later he served in the same capacity with the Grand Trunk at Port Hope, Ont. In 1911 he was appointed district engineer with that company at North Bay, Ont., and in 1915 became division engineer again at Toronto. After war

G. P. MacLaren

service he resumed his position with the railway as district engineer at Toronto. In 1921, Mr. MacLaren was appointed engineer maintenance of way, Canadian National, at Toronto, and in 1926 was transferred to Montreal to take the position he held at the time of his death.

Association News

Roadmasters Association

Four of the committees have already completed their reports for presentation at the convention. President W. O. Frame plans to call a meeting of the Executive committee early in August at which the reports of committees will be reviewed and details of the program completed for the fifty-third annual convention, which will be held at the Hotel Stevens, Chicago, on September 20-22.

Bridge and Building Association

The committees are rapidly completing work on their reports and these reports will be reviewed by the Executive committee at a meeting which President C. M. Burpee plans to call late in August. The association is planning a number of innovations which will add materially to the value of the convention this year in meeting the problems now confronting bridge and building men. The meeting will be held at the Hotel Stevens, Chicago, on October 18-20.

Bridge and Building Supply Men's Association

At a meeting of members in Chicago on July 25, it was decided that, in view of the conditions now prevailing among the companies selling to the bridge, building and water service departments of the railways, no exhibit will be held during the convention of the American Railway Bridge and Building Association this year. A short business meeting of representative member companies will, however, be held during the convention to determine the future course of action for the association.

Metropolitan Track Supervisors Club

With 116 members and guests in attendance, the annual outing of the club, which was held at the Houvenkopf Country Club, Suffern, N.Y., on June 30, was the most largely attended stag outing that this club has ever held. The program included a variety of sports events and, following a buffet luncheon, the last business session of the club for the season was held, the most important feature of which was the election of officers for the ensuing year. In this election J. P. Ensign, assistant engineer of track, New York Central, was advanced from first vice-president to president; T. F. Langan, supervisor of track, Delaware, Lackawana & Western, was elevated from second vice-president to first vice-president; P. N. Wilson, superintendent of maintenance, Brooklyn-Manhattan Transit Lines, was elected second vice-president; and W. E. Bugbee, Eastern Railway Supplies, was elected secretary-treasurer, succeeding George M. Cooper, Ramapo-Ajax Corporation. Members elected to the Executive committee are: J. R. MacAsy (retiring president), supervisor of track, Erie; W. L. Kelly, general roadmaster, Erie; John M. Reardon, supervisor of track, New York, New Haven & Hartford; Oscar Surprenant, roadmaster, Delaware & Hudson; and Mr. Cooper.

Track Supply Association

Thirty-nine companies had arranged on July 23 to present exhibits coincident with the convention of the Roadmasters Association. Although the notices went out to members about 30 days later this year than a year ago, the number of companies that have arranged for space approximates the number that had arranged for space at this time last year and insures an exhibit comparable with that of a year ago, which exhibit was the largest and most representative for several years. Further applications for space should be addressed to Lewis Thomas, secretary, Track Supply Association, % Q & C Company, 57 East Van Buren street, Chicago.

The companies that have arranged for space to date follow:

Air Reduction Sales Co., New York
American Fork & Hoe Co., Cleveland, Ohio
Austin-Western Road Machinery Co., Aurora, Ill.
Barco Manufacturing Co., Chicago
Buda Co., Harvey, Ill.
Chipman Chemical Co., Inc., Bound Brook, N. J.
Creepcheck Co., Inc., Chicago
Crerar, Adams & Co., Chicago
Cullen-Friestedt Co., Chicago
DeSanno & Son, Inc., A. P., Philadelphia, Pa.
Duff-Norton Manufacturing Co., Pittsburgh, Pa.
Elastic Spike Corp., New York.
Fairmont Railway Motors, Inc., Fairmont, Minn.
Hubbard & Co., Pittsburgh, Pa.
Illinois Malleable Iron Co., Chicago
Jordan Co., O. F., East Chicago, Ind.
Maintenance Equipment Co., Chicago
Mall Tool Co., Chicago
Metal & Thermit Corp., New York
Morden Frog & Crossing Works, Chicago
Nordberg Manufacturing Co., Milwaukee, Wis.
Northwestern Motor Co., Eau Claire, Wis.
Oxweld Railroad Service Co., Chicago
P & M Co., Chicago
Pettibone Mulliken Corp., Chicago
Pocket List of Railroad Officials, New York
Positive Rail Anchor Co., Chicago
Q & C Co., New York
Rail Joint Co., Inc., New York
Rails Co., New Haven, Conn.
Railway Engineering and Maintenance, Chicago
Ramapo Ajax Division (American Brake Shoe & Foundry Co.), New York
Reade Manufacturing Co., Jersey City, N.J.
Republic Steel Corp., Cleveland, Ohio
Standard Equipments, Inc., New York
Templeton, Kenly & Co., Ltd., Chicago
Warren Tool Corp., Warren, Ohio
Woodings Forge & Tool Co., Verona, Pa.
Woolery Machine Co., Minneapolis, Minn.

American Railway Engineering Association

As planned and announced in the July issue, the June-July Bulletin, No. 404, was sent to members of the association during July, as well as the Proceedings of the 39th annual convention, held on March 15-17, inclusive. At the same time, the looseleaf supplements to the Manual, necessitated by action at the last convention, were prepared and are now in the hands of the printer.

Five committees held meetings during the last month as follows: Track, at Cincinnati, Ohio, on July 6; Iron and Steel Structures, at Buffalo, N.Y., on July 7-8; Maintenance of Way Work Equipment, at Philadelphia, Pa., on July 12-13; Records and Accounts, at Chicago, on July 13; and Economics of Railway Location and Operation, at Detroit, Mich., on July 14-15. Only one committee has scheduled a meeting during August, this being the Committee on Buildings, which will meet at Detroit on August 10.

Supply Trade News

The Nordberg Manufacturing Company, Milwaukee, Wis., has appointed **La Consolidada, S. A.,** Calzada de la Ronda, Apartado 81, Bis, Mexico, D. F., Mexico, its distributor in charge of sales and service in Mexico for the complete line of Nordberg power tools and Symons cone crushers and screens.

E. F. Tegtmeyer, assistant manager of the railway sales division of the **Standard Oil Company of Indiana,** retired on company annuity on July 1, after 23 years' service.

Calvin Verity, executive vice-president and assistant general manager of the **American Rolling Mill Company,** Middletown, Ohio, has been elected executive vice-president and general manager; **W. W. Sebald,** vice-president in charge of commercial activities has been elected vice-president and assistant general manager.

Charles M. Griffith, vice-president in charge of track work sales of the **Taylor-Wharton Iron & Steel Company,** High Bridge, N.J., has retired after 50 years continuous service, but will be available to the company in a consulting and advisory capacity. **J. A. Krugler,** general sales manager, will have charge of trackwork sales.

W. J. Mayer, has joined the staff of the **A. M. Byers Company,** Pittsburgh, Pa., as a sales engineer. He will work out of the company's Philadelphia division office, and his territory will include Baltimore, Md., and the south.

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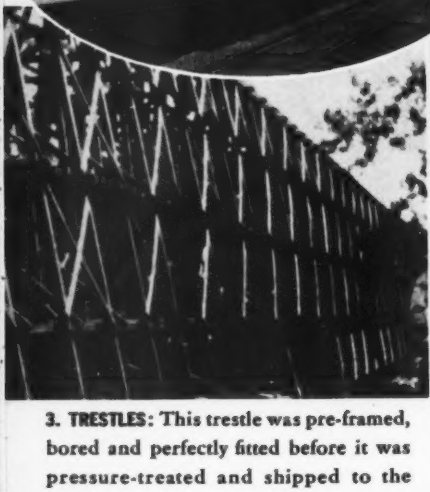
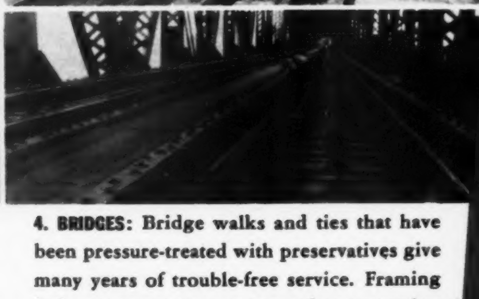
2. STATION PLATFORMS: (Left) Station platforms built of pressure-treated creosoted timber resist wear and decay. Lumber for work of this kind may be fabricated before treatment at plants of the Wood Preserving Corporation, thus avoiding the necessity of cutting or sawing on the job.





3. TRESTLES: This trestle was pre-framed, bored and perfectly fitted before it was pressure-treated and shipped to the erection site by the Wood Preserving Corporation.

4. BRIDGES: Bridge walks and ties that have been pressure-treated with preservatives give many years of trouble-free service. Framing before treatment assures complete protection for all parts of the structural member.

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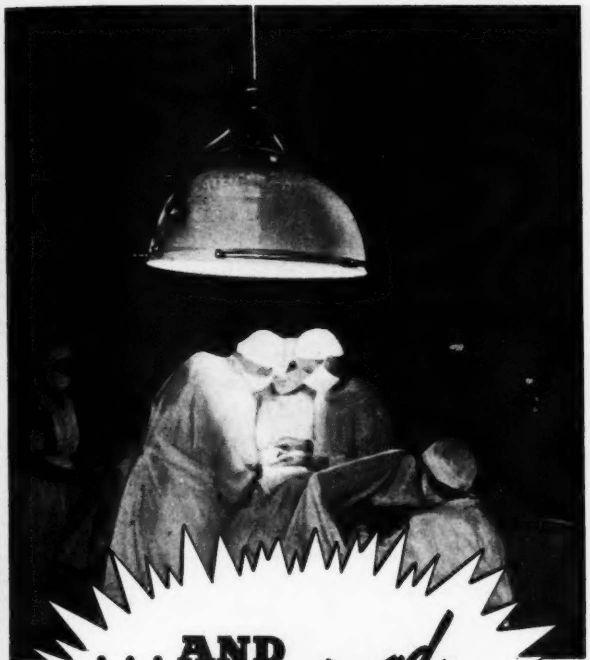

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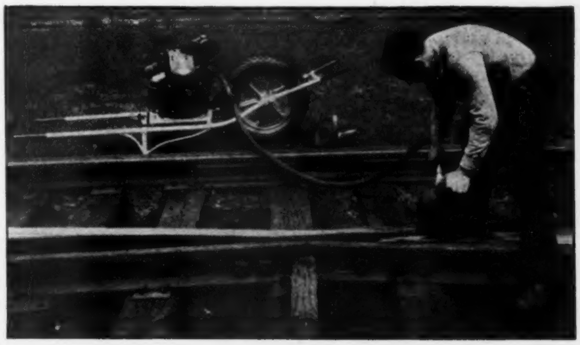

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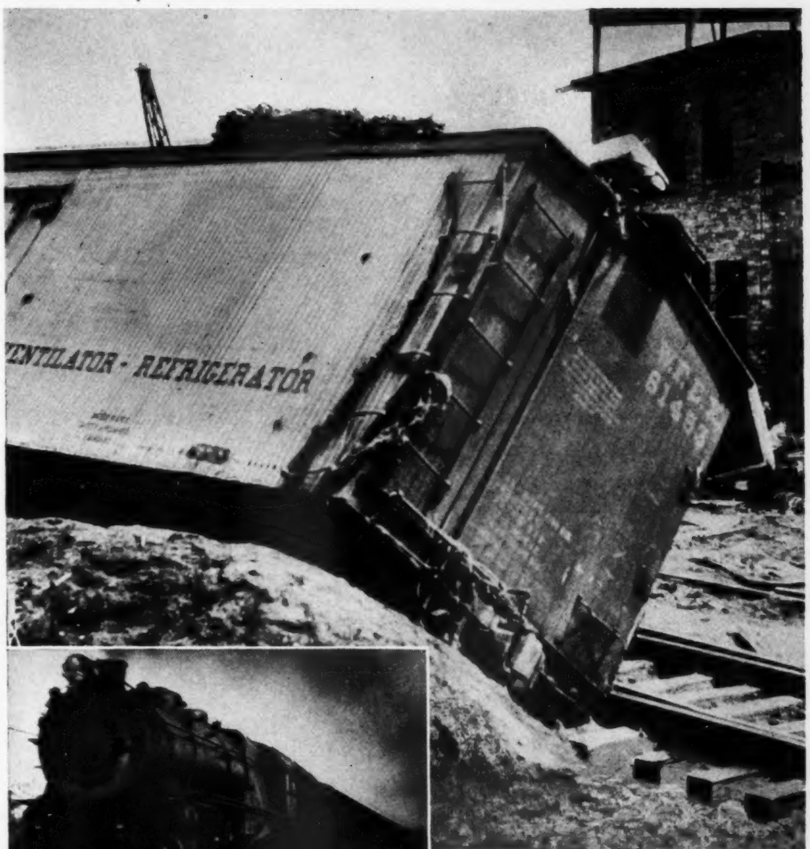

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